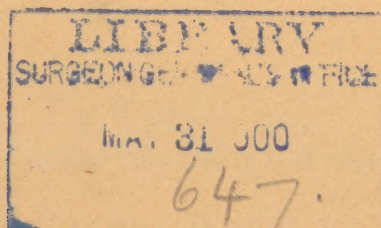


MILLER (W.D.)

THE
HUMAN MOUTH AS A FOCUS OF INFECTION.

BY W. D. MILLER, M.D., D.D.S., BERLIN.

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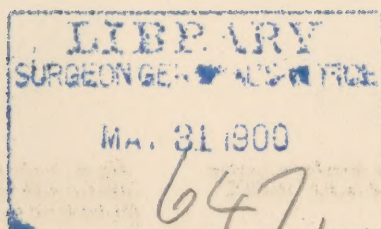


PLATE I.

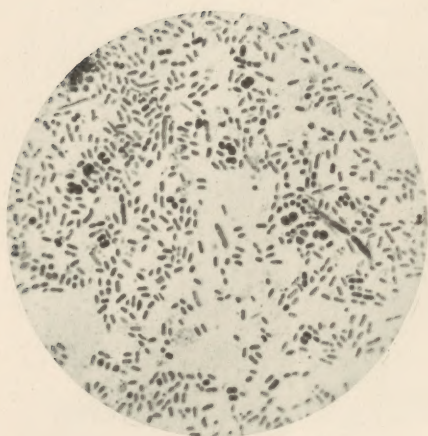


Fig. 1. Bacteria from a serous peritoneal exudate of a mouse infected with saliva. Methyl violet. 1000:1.

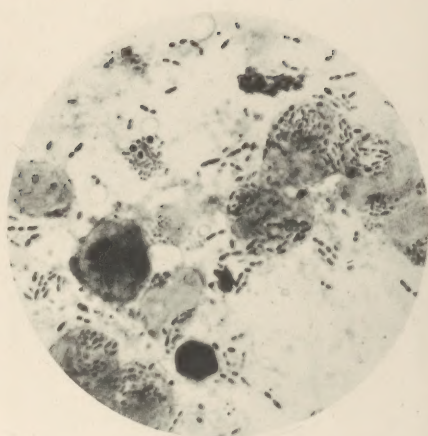


Fig. 2. Bacteria from a purulent peritoneal exudate of a mouse infected with saliva. Methyl violet. 1000:1.

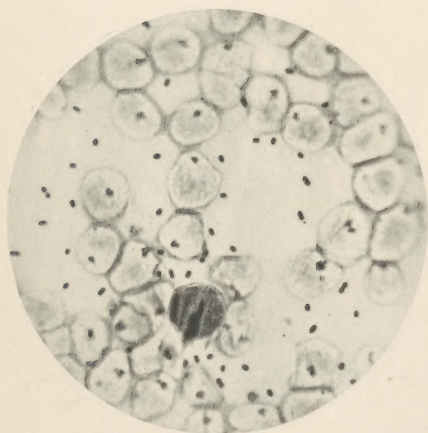


Fig. 3. Diplococci from the blood of a mouse infected with saliva. Methyl violet. 1000:1.

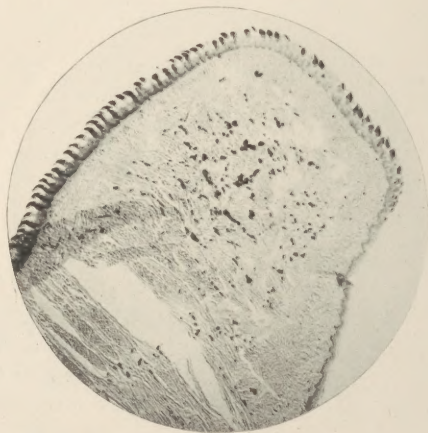


Fig. 4. Section through tip of tongue of a mouse infected with saliva, showing colonization of the bacteria in the tongue. Methylene blue. 20:1.

PLATE II.

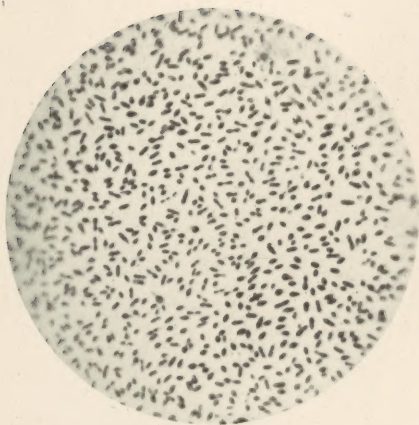


Fig. 5. Micrococcus of Sputum Septicæmia I. Pure culture from blood of mouse, on blood-serum, one day old. Gentian violet. 1000:1.

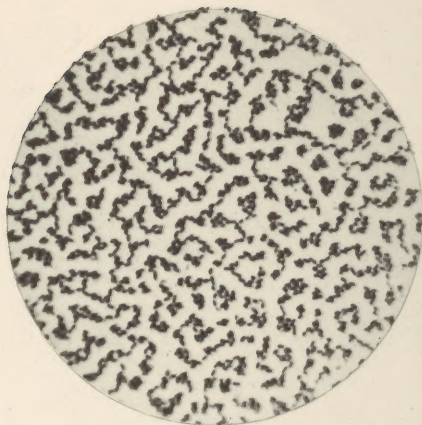


Fig. 6. Micrococcus of Sputum Septicæmia IV. Pure culture from blood of mouse, on blood-serum, one day old. Gentian violet. 1000:1.

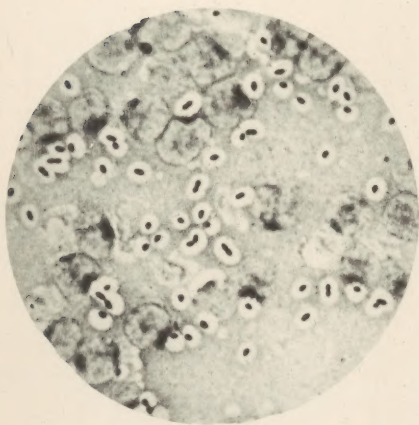


Fig. 7. Blood of mouse infected with Micrococcus I, showing halo. Gentian violet. 1000:1.

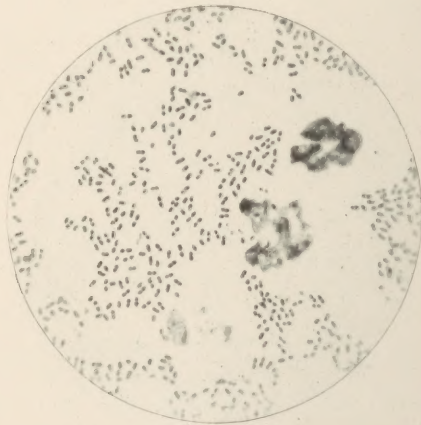
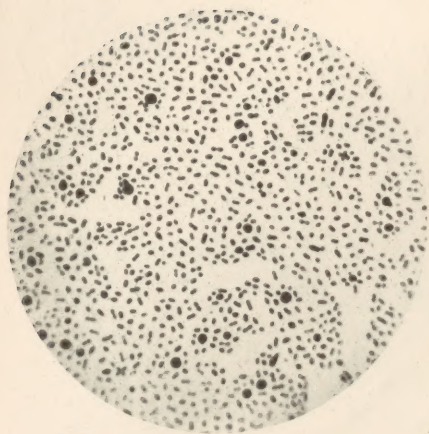


Fig. 8. Peritoneal liquid from mouse infected with Micrococcus I. Methylene blue. 1000:1.



* Fig. 9.—*Micrococcus* of *Sputum Septicæmia* III.
Pure culture on blood-serum, four days old.
Methyl violet. 1000:1.

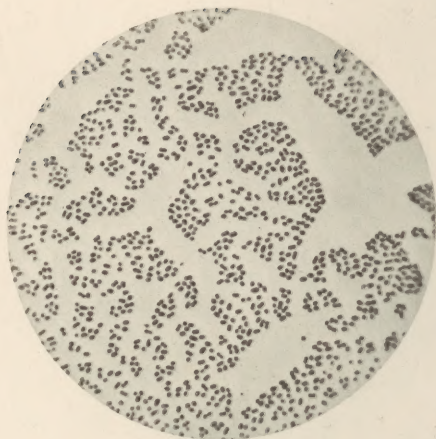


Fig. 10.—*Micrococcus* of *Sputum Septicæmia* III.
Pure culture on blood-serum, one day old.
Ribberts solution. 1000:1.



Fig. 11.—*Micrococcus* of *Sputum Septicæmia* II.
Culture on blood-serum, one day old.
Methyl violet. 1000:1.

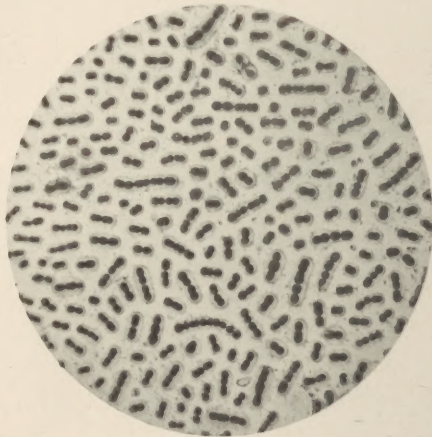


Fig. 12.—*Micrococcus* of *Sputum Septicæmia* II.
Culture on agar, one day old, showing capsules.
Gentian violet. 1000:1.

PLATE IV.



Fig. 13.—*Bacillus* of *Sputum Septicæmia*. Portion of a colony on gelatine. Impression preparation. Gentian violet. 1000:1.

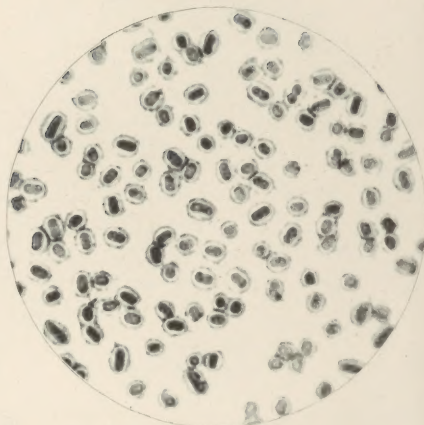


Fig. 14.—*Bacillus buccalis muciferens*. Pure culture on agar, one day old. Gentian violet, 1000:1.

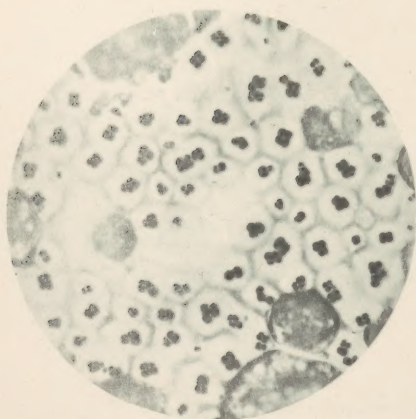


Fig. 15.—Peritoneal slinky, purulent exudation from a mouse infected with saliva, showing a pure culture of *M. tetragenus*. Methylene blue. 1000:1.

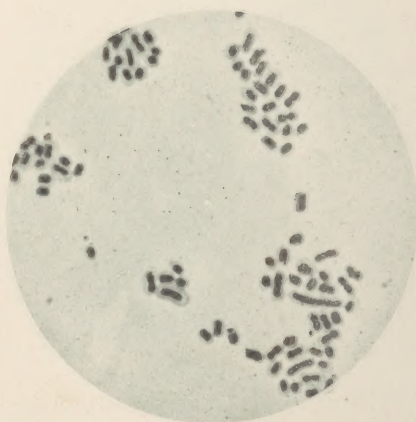


Fig. 16.—*Pneumobacillus*. Pure culture, showing capsules. Gentian violet. 1000:1.

PLATE V.

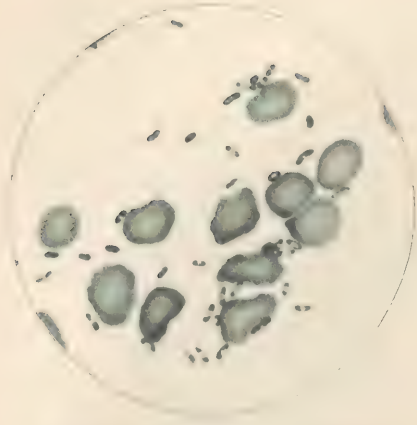


Fig. 17: Bacillus buccalis septicus.
From the blood of a mouse. Methyl violet.
1000:1.

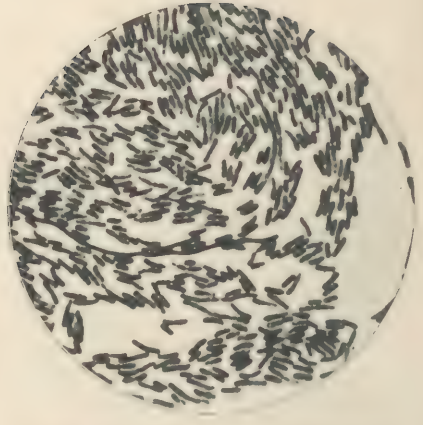


Fig. 18: Bacillus buccalis septicus.
Pure culture on gelatine, one day old.
Methyl violet. 1000:1.

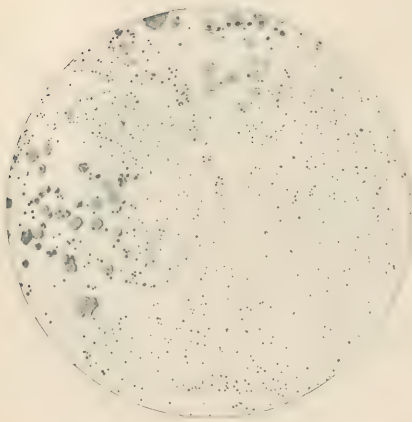


Fig. 19: Bacillus buccalis septicus.
Plate culture on gelatine, three days old.
Nat. size.

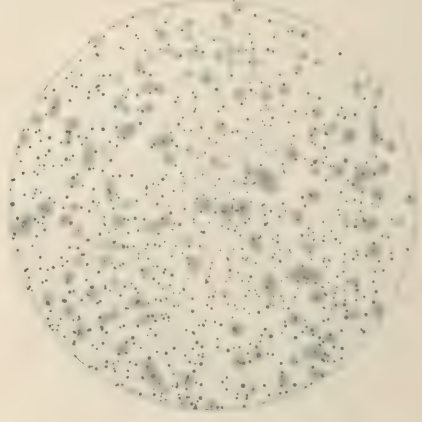


Fig. 20: Bacillus of Spidum Septicæmia.
Plate culture on gelatine, three days old.
Nat. size.

THE HUMAN MOUTH AS A FOCUS OF INFECTION.

BY W. D. MILLER, M.D., D.D.S., BERLIN.

DURING the last few years the conviction has grown continually stronger, among physicians as well as dentists, that the human mouth, as a gathering-place and incubator of diverse pathogenic germs, performs a significant rôle in the production of varied disorders of the body, and that if many diseases whose origin is enveloped in mystery could be traced to their source, they would be found to have originated in the oral cavity.

It shall be my endeavor in the following pages (1) to call attention to the various diseases, both local and general, which have been found to result from the action of micro-organisms which have collected in the mouth, and to the various channels through which these micro-organisms or their waste products may obtain entrance to parts of the body adjacent to or remote from the mouth. The secondary nervous affections due to diseased teeth will not receive consideration; (2) to present in very brief form the present condition of our knowledge of the pathogenic bacteria met with in the mouth and the means at our command for combating them. I shall refer only cursorily to those topics which are of minor importance, or which have already become familiar to the profession through the periodicals, text-books, etc., giving more attention to those which are still subjects of study. I hope finally to be able to add some results of original investigations in this field, which may help to establish the great importance of a thorough understanding on the part of the physician, no less than of the dentist, of mouth-germs as a factor in the production of disease. The subject will be presented under the three following heads:

I. Disturbances of the Human Body which have been traced to the Action of Germs growing in the Mouth.

II. The Pathogenic Mouth-Bacteria.

III. Prophylactic Measures.

I. DISEASES OF THE HUMAN BODY WHICH HAVE BEEN TRACED TO THE ACTION OF MOUTH-BACTERIA.

1. *Decay of the Teeth.*

In conformity with the nearly unanimous verdict of all recent investigations, decay of the teeth must be set down as the most widespread of all parasitic diseases to which the human body is subject ; and although, as far as the life of the patient is concerned, the prognosis is exceedingly good and decay of the teeth may be pronounced one of the most trivial disturbances in the human economy, yet, if we take into consideration the results which follow a case of general decay, particularly in the mouth of young or weak persons, it often becomes a disease of very grave nature.

I venture to say that most practitioners of dentistry will agree with me that the havoc wrought by dental caries in the mouths of vast numbers of children, or even adults, among the lower classes is a much more serious thing than an attack of chicken-pox, rubeola, or even measles.

2-4. *Pulpitis, Gangrene of the Pulp, Pericementitis.*

Inflammation of the dental pulp, with the exception of the comparatively few cases where it is the result of trauma or of calcareous formations in the pulp-chamber, erosion, abrasion, etc., is due directly or indirectly to parasitic influences, while gangrene of the pulp can never have any other origin under any circumstances.

Pericementitis apicalis, the form of pericementitis which is most severe and gives rise to the most serious consequences, is likewise of parasitic origin, being produced by germs or their products, or by both together passing from the root-canal through the apical foramen.

That the pain attending a severe case of pulpitis or pericementitis is usually of so intense a character as to make it a very serious matter to the person who has to bear it, is too well known to need any comment. That the sufferer usually receives so little sympathy is to be accounted for by the fact that the direct mortality is almost zero, while the eventual loss of the tooth is often short-sightedly regarded as a matter of little consequence, in consideration of the fact that it is only one of a large number, and may eventually be replaced by a better one of porcelain, which cannot ache.

5. *Alveolar Abscess.*

Alveolar abscess is an infectious disease, primarily of a local character, but frequently, or usually, accompanied by general symptoms of varying intensity, and sometimes attended by complications of a most serious nature. Severe cases of alveolar abscess, particularly in weak persons, not unfrequently present symptoms of an alarming nature. The extensive œdema, general debility, fever, chills, forcibly suggest the thought of a general infection, which, it must be admitted, is always possible where large masses of pus accumulate about the point of the root.

Leaving out of account for the present the more common complications of alveolar abscess, I wish to call particular attention to the many cases in which it has terminated fatally through the supervention of septicæmia or pyæmia.

It must be constantly borne in mind that wherever micro-organisms are accumulated in large masses in any part of the body, the possibility of their being carried to other parts through the blood or lymph-channels, and of their producing, accordingly, metastatic abscesses wherever a point of diminished resistance exists, can never with certainty be excluded. It has been repeatedly observed that most stubborn cases of chronic pyæmia, which have baffled all attempts of physicians either to cure them or to determine their cause, have disappeared on the removal or proper treatment of a diseased tooth. In like manner, general blood-poisoning (septicæmia), with speedily fatal termination, has been seen to result from accumulations of infectious material about the roots of a tooth.

The cases 1-70 of the table, pages 18-25, which I am convinced are but a small proportion of those which have actually occurred, may serve to illustrate this category of infections through alveolar abscess.

6 and 7. *Ostitis, Osteomyelitis.*

Ostitis and osteomyelitis belong to the more common complications of decay of the teeth. Every severe inflammation of the pericementum is naturally accompanied by more or less inflammation of the bone-marrow, or of the bone (osteitis), or of both together (osteomyelitis). Severe cases of osteomyelitis, fortunately of comparatively rare occurrence, are of exceedingly doubtful prognosis. Schede (table, 7-14) reports nine cases, of which all but one ended fatally, death resulting from acute or chronic sepsis, or from a spreading of the infection through the floor of the mouth and retrotonsillar tissue into the mediastinum, producing pleuritis, pericarditis, etc., with purulent exudations.

In the table many cases of osteomyelitis resulting from diseased

conditions of the teeth or from operations upon them will be found. I refer in particular to Nos. 1-16, also 71, 76, and 77. It is worthy of remark that these cases occurred, almost without exception, in the lower jaw.

8 and 9. *Periostitis and Necrosis.*

A slight inflammation of the periosteum of the alveolar process and a slight necrosis of the bone necessarily accompany all abscesses in which the pus makes its way to the surface of the bone; ordinarily, however, the symptoms are of minor importance, and disappear as soon as the pus has discharged through the gums.

Not unfrequently, however, periosteal inflammations resulting from caries are of an exceedingly violent character; intense, continuous pain, often lasting for days, enormous swelling, debility, fever, chills, sometimes terminating fatally, as many cases in dental and medical literature show, through pyæmia or septicæmia, after an intervening stage of phlegmon.

Köhler* observed in two years forty-four cases of periostitis, which in some had led to extensive necrotic destruction. The periostitis proceeded often from diseased roots and quite as often from extractions, which by no means seldom lead to a kind of gangrene of the mouth (*gangræna acutissima*), and occasionally to general sepsis. "Consequently this little operation must in the future be carried out more in accordance with the fundamental principles of antiseptis than has been the case in the past."

Necrosis is but a more advanced stage of osteomyelitis and periostitis. The bone, deprived of all sources of nutrition, dies (becomes necrotic), and is afterward thrown off by the surrounding tissue in the form of a so-called sequestrum.

Whether the periostitis and necrosis result from a diseased condition of the teeth or of the gums (stomatocæ, noma), or accompany certain general diseases (syphilis, scrofula, the exanthemata), or follow upon the incorporation of certain mineral poisons (mercury, phosphorus, lead, arsenic), or, finally, result from traumatic injuries or impeded eruption of the wisdom-teeth, in many cases the sole agent, and in all an important one, in bringing about the disturbance is to be found in the bacteria of the human mouth.

Undoubtedly nearly all the cases given in the table were more or less complicated by periostitis, it being often lost sight of on account of other more serious symptoms. I call attention to Nos. 16-27, 77, 78, and 80-90, from which it will be seen again that the lower jaw is the usual seat of the trouble.

* *Charité Annalen.* Jahrg. XIV and XV, 1888-89.

10. *Dental Fistulæ.*

In this connection I refer in particular to those fistulæ of dental origin which open on the neck, shoulder, arm, or breast, thus giving rise to so-called "running sores," which of course defy all treatment until the true source is discovered.

Nicolai (table, 56) relates a case where the connection of a chronic fistula on the breast just above the nipple was discovered by the discharge, on the day following a visit to the dentist, smelling like the medicament used by the dentist in treating a badly diseased root. A solution of cochineal injected into the root also made its appearance at the opening of the fistula a few hours later.

11. *Septicæmia.*

Many cases may be found in medical and dental literature in which a general infection of the blood causing the death of the patient in a few hours has resulted from the accumulation of pus about a diseased tooth or from operations in the mouth. Cases 28-31 and 91, 92 are of this nature. Fracture of the mandibula not unfrequently leads to a general septic infection. Malgaigne saw death result from fracture four times in seventeen cases, Richet twice in ten. Unfortunately, we know absolutely nothing about the specific bacteria present in these different cases, and as far as I know no attempt has ever been made to cultivate them or even to examine the blood and various organs microscopically in any case of septicæmia of dental origin.

12. *Pyæmia.*

Cases of pyæmia resulting from diseased conditions of the mouth and teeth are of more frequent occurrence than those of septicæmia, and in some respects of greater interest, particularly to the practitioner of medicine.

Chronic pyæmia presents itself in form of abscesses of varying intensity occurring in different parts of the body, healing spontaneously at one point, only to break out again at some other more or less remote. An abscess at the point of the finger or on the toe may originate in a diseased tooth as well as an abscess at the point of the root. The focus of infection maintained by the diseased tooth constantly gives up its virus to the blood or lymph by which it circulates through the system, and, under favorable conditions, establishes itself at any point where, at the time, there may be a diminished vitality, or in other words, a *locus minoris resistentiæ*. In all cases of chronic pyæmia a thorough inspection of the oral cavity should be made by a dentist or by a physician whose education in regard to oral pathology has not been so entirely neglected as heretofore has usually been the case.

A number of cases of pyæmia of dental origin will be found in the table, Nos. 32-47, 75, 90, 93, etc.

13. *Meningitis, Encephalitis, Abscess of the Brain, etc.*

It may at first thought not appear quite clear how an inflammation of the brain or its membranes, abscess of the brain, etc., may be brought about by carious teeth. A superficial examination of the relations of the teeth to the cavity of the skull will, however, show us that an inflammatory process incited by the teeth of the upper jaw may reach the brain cavity either through the maxillary sinus, nasal cavity, and cribriform plate of ethmoid bone (or directly through the nasal cavity and ethmoid), or through the pterygoid fossa and foramina at the base of the skull, or by way of the sphenomaxillary fossa, inferior sphenoidal fissure, orbit, etc. Inflammatory processes in the lower jaw ascending the ramus usually obtain entrance to the skull cavity by way of the orbit, less frequently, it seems, through the pterygoid fossa. Septic meningitis may be produced by germs obtaining entrance to the blood through wounds or abscesses and lodging at some weak point on the brain, while the possibility has been suggested that the micrococcus of sputum septicæmia may enter the blood through the lungs without the intermediary stage of pneumonia. Finally, inasmuch as croupous pneumonia is caused by a mouth-germ, so must the metastatic meningitis of pneumonia be looked upon as the work of a mouth-germ. Cases will be found in the table, Nos. 47-49, 54, 55, 64, 96-101, 117, 119, etc.

14. *Impeded Eruption of Wisdom-Teeth.*

The chronic state of irritation upon the gums and periosteum resulting from impacted wisdom-teeth, and the consequent state of diminished resistance, make it possible for micro-organisms, which obtain entrance between the crown of the tooth and the overlapping gums (assisted as they so frequently are by the irritating action of small particles of food undergoing fermentation), to multiply in large numbers and, penetrating along the course of the distal root into the depths of the jaw, to bring about the series of disturbances, ostitis, osteomyelitis, periostitis, phlegmon, trismus, and in some cases necrosis or even septicæmia. It is one of the many cases where bacteria which may be present in the mouth without leading to any disastrous results as long as the soft tissues are in a perfectly healthy condition, never allow any opportunity presented by the diminished resistance of the tissue to escape their notice. (See table, 117-120.)

15. *Pyorrhæa Alveolaris.*

There are many reasons for believing that pyorrhæa alveolaris has

an origin similar to that of the suppurative processes associated with the impeded eruption of the lower wisdom-teeth. A predisposing cause which may be in part general and in part local sufficiently impairs the resistance to allow the pyogenic bacteria of the mouth to gain a footing. This view, which I have maintained for years, was supported by Galippe in a paper read before the dental section of the International Medical Congress, 1890. He found chiefly streptococci in all cases of pyorrhea alveolaris recently examined.

The evil results of allowing this disease to gain the upper hand manifest themselves not only in the impairing or complete loss of the efficiency of the teeth as organs of mastication, but also, as has been expressed by Galippe, when a secretion of matter in the mouth becomes general patients may suffer from fever, loss of appetite, stiffness, severe disturbances of the alimentary canal, insomnia, subicteritic discoloration of the skin, etc.

16. *Disturbances in the Alimentary Tract.*

The mouth, as has been sufficiently well established, furnishes one of the chief sources for the constant recruiting of the bacteria of the stomach and intestines. Not only this, but the constant swallowing of decomposing matter and of pus from an improperly cared for mouth may lead to the most serious disturbances, both acute and chronic. Particularly where a chemical or mechanical insufficiency of the stomach exists, the digestive process, and consequently the general health of the patient, is sure to suffer severely when the care of the mouth is neglected.

We have known patients under treatment for troubles of the digestive tract to most scrupulously sterilize all articles of diet and then pass them through a mouth seldom visited by a tooth-brush, thereby incorporating with them millions of bacteria. In all troubles of the digestive tract, too much care cannot be bestowed upon the antisepsis of the mouth.

17. *Diseases of the Lungs.*

a. *Croupous Pneumonia.*

The uniform results obtained by investigators on the subject of pneumonia for the last five years leave little room for doubt that the cause of this important disease is to be sought for in a species or group of micro-organisms which are constantly present in the sputum of persons suffering from pneumonia, and very frequently even in the saliva of quite healthy people. This micro-organism, or group of micro-organisms, will be discussed at length later on. At present I wish

to emphasize only the fact that pneumonia owes its origin to a mouth-bacterium.

Furthermore, there is much reason in the arguments of Meltzer,* who claims that it is impossible for micro-organisms from the air to obtain direct entrance into the alveoli of the lungs through the air-passages with their numerous crooks and turns; that they first lodge in the mouth or pharynx, from which they may, by a strong inspiration, be carried with particles of mucus into the broncheoli, to be then finally driven into the alveoli through the pressure of the air in the broncheoli during the middle phase of the act of coughing.

This view is supported by the fact, as shown by the investigations of Hildebrandt,† that the trachea, bronchi, etc., of healthy animals contain no living germs. Hildebrandt, moreover, came to the conclusion, after a series of very careful experiments, that by far the greater part of the bacteria of the air lodge in the mouth, nose, or throat, and that under ordinary circumstances these cavities furnish an almost perfect filter for the air. Again, it is highly improbable that the number of germs inhaled at any one time would be sufficiently great to maintain themselves in the human lungs without having undergone at least a temporary stay in the mouth, which serves as their recruiting- or breeding-place.

Furthermore, the micrococcus of pneumonia not only does not proliferate at the ordinary temperature of the air, but, what is of still greater importance, soon loses its virulence when cultivated out of the body even under the most favorable conditions, which is still another potent reason for the supposition that in pneumonia the mouth and not the air is the direct source of the infection.

b. Gangrene of the Lungs.

Bonome‡ examined seven cases of gangrene of the lungs, and found in all seven the pyogenic staphylococci,—*Staphylococcus pyogenes aureus* and *albus*. He concludes that the necrosis of the lung-tissue is due to these micro-organisms alone, whereas the putrefactive processes are brought about by any ordinary saprophytic bacteria which may obtain entrance to the necrosed parts. The former are frequent, the latter constant inhabitants of the oral cavity, and the probability that the invasion takes place from the mouth is at least very great.

Positive evidence in support of this supposition was furnished by

* Über die mechanischen Verhältnisse bei der Entstehung der Pneumonie. (*Med. Monatsschr.*, Feb. 1889.)

† Beiträge zur pathol. Anatomie u. Physiologie von Ziegler und Nauwerck. Bd. II, 1888, S. 143.

‡ Giornale della R. Accademia di Medicina, 1886, No. 7.

Leyden and Jaffé, who found in putrid sputum micro-organisms which hitherto have never been met except in the oral cavity.

The relation of mouth-germs to actinomycosis of the lungs will receive consideration later on.

18. *Infiltration of the Surrounding Tissue and Chronic Swelling of the Lymphatic Glands in the Region of the Lower Jaw and Neck.*

The causal relation of a diseased condition of the teeth to this affection has been clearly enough established by Odenthal,* who found glandular swellings in ninety-nine per cent. of all children who suffered from badly decayed teeth, and only in forty-nine per cent. of those with sound teeth. We are not so much surprised at this result, inasmuch as every practitioner must have repeatedly observed marked swelling and soreness of the glands of the neck concomitant with pericementitis of the lower bicusps and molars.

19. *The Infectious Anginæ (Tonsillitis, Amygdalitis Infectiosa, etc.)*

It is now commonly recognized that the tonsils may harbor various pathogenic bacteria in their lacunæ without any appreciable evil consequences, until, through some cause or other, which may be of a very trivial nature, their action manifests itself either in form of a local or general infection. Particularly tonsils which are chronically inflamed, hypertrophied, are dangerous accumulators of pathogenic germs, and for this reason Bouchard † recommends their destruction by ignipuncture, while von Hoffmann ‡ obliterates the lacunæ by tearing with a blunt hook through the bridges connecting the neighboring lobes of the tonsils. He thereby not only destroys the recesses which so often contain masses of pus, bacteria, etc., in a state of putrefaction, but also produces a marked contraction of the hypertrophied gland. This operation is recommended as a prophylactic measure of great importance against diphtheria.

A. Fränkel|| gives an account of two cases of severe septic infection proceeding from the organs of the throat. In the first case the disease began with a diphtheritic affection of the tonsils, and resulted in a retropharyngeal phlegmon, pericarditis, and pleuritis. In the pericardium he found a liter of pus, in the right pleural cavity extensive purulent, and in the left, sero-fibrous exudations. Cyanosis and dyspnoea were present.

Heubner and Bahrdt reported similar cases in 1884.

* Inaugural Dissertation. Bonn, 1887.

† *Thérapie des maladies infectieuses*, p. 256.

‡ *Theurapeutische Monatshefte*, October, 1889, p. 441.

|| *Deutsche Med. Wochenschr.*, 1887, No. 15, p. 553.

In the second case before mentioned, there developed endocarditis ulcerosa, broncho-pneumonia, cloudy swelling of the kidney, infarction of the spleen. The tissues of both tonsils were infiltrated with sero-purulent matter, septic infection proceeding from the organs of the throat by means of staphylococci.

Fürbringer, in the discussion on Fränkel's cases, calls attention to the many cases where one is obliged to write "unknown mykosis," and records (1) a case of sepsis following upon a swelling of one of the tonsils; (2) a case of sepsis resulting from carious teeth (on the right and left side, respectively, one carious lower tooth), first giving rise to inflammation of the subgingival connective tissue, periostitis, and phlegmon; (3) a case of endocarditis ulcerosa and embolic meningitis resulting from a suppurating tonsil.

Apolant records a case of pyæmia, and Leyden a case of retro-pharyngeal abscess resulting from sore throat.

Numerous cases have been recently reported before the Société Médicale des Hôpitaux.

Among others, MM. Féréol et Rendu* report cases of phlegmon of the cellular tissue surrounding the larynx and œsophagus, followed by respiratory and cardiac troubles. Féréol† also reports a case of amygdalitis resulting fatally in five days through the supervention of a general infection. This case was characterized by a hiccough lasting through the whole sickness.

The authors just named demand that the most scrupulous attention be paid to troubles of the organs of the throat, even when they are of most trivial appearance.

Little is known as to the specific micro-organisms concerned in these cases. Bouchard‡ found enormous numbers of small bacteria in a case of phlegmonous amygdalitis. Cornil|| found streptococci in a case of abscess of the tonsils.

20. *Angina Ludovici*

presents itself as an inflammation of the cellular tissue beneath the lower jaw, giving rise to an exceedingly hard swelling, which may extend from the border of the lower jaw to the sternum. It may terminate fatally, either through œdema of the glottis, or, when supuration takes place, through general sepsis. Under the name of Angina Ludovici, writes Tissier,§ we understand an infectious septic process, characterized by an induration with a tendency to gangrene,

* *Annales de Médecine*, Mai 27, 1891.

† *Journal des Connaissances Médicales*, 1891.

‡ Vid. David, *Les Microbes de la Bouche*, p. 170.

|| Cornil et Babes, *Les Bactéries*.

§ *Progrès médical*, 1886, p. 514.

always appearing under the same symptoms, *resulting from a primary lesion of the mouth, which serves as point of entrance to the germs.*

Sufficient evidence has been accumulated* to render it highly probable that this severe, though rare affection, is the result of the invasion of micro-organisms through slight wounds, ulcerations, or other breaks in the continuity of the mucous membrane, or by way of diseased teeth, or of the tonsils, or of the ducts of the sublingual and submaxillary glands.

21. *Diseases of the Maxillary Sinus*

are of such frequent occurrence that every practitioner must have seen one or more cases. It is not necessary to refer to the fact that they are in the vast majority of cases the result of the action of mouth-bacteria.

Complications of these troubles which require particular mention are diseases of the nasal cavity, chronic catarrh of the frontal sinuses with constant flow of offensive mucus, spreading of the affection to the orbit and hence to the brain, or through the cribriform plate of the ethmoid to the brain, resulting in abscess of the orbit, abscess of the brain, meningitis. (Cases 49, 52, 65, 114.)

22. *Pneumococcus Abscesses.*

It has been well established that the so-called pneumococcus possesses invasive properties of the highest order, so that there is hardly any part or organ of the human body which may not fall a prey to its action.

Leaving out of account the croupous pneumonia and its sequels, such as pleuritis, pericarditis, oedema, emphysema, embolic meningitis, etc., we may mention here parotitis, multiple subcutaneous abscesses,† tonsillitis,‡ otitis media, abscesses of the mastoid process,|| peritonitis and meningitis (independent of pneumonia), etc. In such cases the coccus is transported from the mouth to other parts of the body through the blood or lymphatics, or as is often the case in otitis, meningitis, etc., by a direct spreading of the affection from the mouth to the neighboring cavities. The possibility has also been suggested of the pneumococcus obtaining entrance to the blood through the lungs and giving rise to a primary peritonitis, endocarditis, meningitis, etc., without the intervening stage of pneumonia.

* Chantemesse et Vidal (v. David, *Microbes de la Bouche*, p. 173).

† Testi, *Riforma medica*, 1889, Nos. 281 and 282.

‡ Gabbi, *Lo Sperimentale*, 1889, fasc. 4.

|| Zanf, *Prager Med. Wochenschr.*, 1889, Nos. 6, 12, 15, and 36; Netter, *Compt. rend. hebd. des séances de la soc. de biol.*, 1889, p. 305.

23. *Disturbances resulting from the Absorption of Products of Putrefaction through the Mucous Membrane of the Mouth.*

In persons of uncleanly habits, who neglect the care of the mouth, and especially who allow rubber plates to remain in the oral cavity for weeks together, constantly covered with a thick coating of putrefying mucus and food, loss of appetite, nausea, vomiting, and chronic indigestion may result from the prolonged action of the products of decomposition upon the mucous membrane of the mouth and pharynx.

24. *Stomatitis Ulcerosa (S. Scorbutica, S. Mercurialis).*

These are nothing more nor less than the result of the invasion of pyogenic and saprophytic bacteria of the mouth upon a tissue which has already suffered a severe diminution in its powers of resistance through the general primary affection. There can be no doubt that the intense suppurative and putrefactive processes often appearing in advanced stages of these diseases are not the result of the action of the mercury or of the general condition known as scorbutus, these serving only to deprive the tissue of its normal power of resistance and so to prepare it for the invasion of the ever-present bacteria. This view, if I have not misinterpreted him, has already been expressed by Galippe.

The same is to a certain extent true of stomatitis diphtheritica, which seldom attacks the normal, healthy mucous membrane of the mouth, as well as of the stomatitis syphilitica, frequently met with in old cases of latent or "cured" syphilis.

25. *Actinomycosis.*

This disease is of so frequent occurrence and its connection with the mouth so apparent, that it requires only to be mentioned to carry with it an argument for a more commensurate estimation of the importance of careful attention to the hygiene of the mouth.

Of two hundred and three cases reported in German medical literature of the last five years, the point of entrance was found to be in the region of the mouth and throat one hundred and twenty times, not including the cases of actinomycosis of the intestines, where also the fungus most probably entered through the mouth. In nine cases the point of entrance was doubtful, and in the remaining seventy-four it was outside of the mouth. How often the infection took place directly from the air or through the food, and how often through germs which had established themselves in the mouth, cannot be determined from the reports.

Actinomycosis threads and glands have by various observers been repeatedly found in the saliva as well as in carious teeth, and in the

lacunæ of the tonsils. Most frequently, carious teeth are brought into causal connection with the invasion, then slight wounds on the mucous membrane, colonization of the fungus in the tonsils, etc.

Imminger,* who examined over one hundred cases of actinomycosis bovis yearly, found the invasion to take place almost invariably from the tonsils.

26. *Noma*,

although a disease of comparatively rare occurrence,† excites particular interest on account of the fearful ravages which it produces and the rapidity with which it advances, so that in the space of three or four days the whole cheek, nose, eyelids, mucous membrane of the jaw and soft palate may be transformed into a necrosed, putrefying mass.

Whereas the majority of older writers on the subject of noma look upon this disease either as a trophoneurosis, or as a necrosis similar in its origin to the decubital ulcers of the throat, the majority of recent investigators are inclined to attribute the chief rôle to certain micro-organisms. Froriep‡ appears to have been the first to call in the aid of a living agency in the form of appearances resembling yeast-fungi, which he found in noma. After him, Strueh|| describes what he calls noma pilz, while Ranke§ found masses of bacteria, almost all cocci, and Cornil et Babes¶ found short chains of micrococci, either free or in zoöglœa.

Schimmelbosh,** to whom I am indebted for some of the above notes, found apparently a pure culture of bacilli on the border of the sound tissue, which he succeeded in cultivating upon artificial media.

Small pieces of necrotic tissue implanted under the skin of the neck of two rabbits caused abscesses, one as large as a cherry, the other three times as large, but no necrosis developed,—a result similar to that obtained by Ranke. Inoculation of rabbits with pure cultures caused œdematous swellings on the conjunctiva, in one case keratitis, in another panophthalmitis. Mice and doves proved immune; two hens showed circumscribed necrosis which healed inside of three weeks.

* Adam's Thierärztliche Wochenschr., 1888, No. 18.

† V. Bruns (Die Chirurgische Pathologie und Therapie der Kau- und Geschmacks-Organen, 1859, Bd. I) collected four hundred and thirteen cases out of the English, French, German, and Dutch literature.

‡ Chirurgische Rupfertafeln, 1884.

|| Ueber Noma und deren Pilze. Inaug. Dissert., Göttingen, 1872.

§ Jahrbuch f. Kinderheilkunde, 1880.

¶ Les Bactéries, second ed., p. 394.

** Deutsche Med. Wochenschr., 1889, No. 26.

Likewise, Grawitz* found bacilli in nearly pure culture. The appearance was described by Loeffler † as similar to that seen in diphtheria of calves.

27. *Pharyngomycosis (Mycosis Tonsillaris Benigna).*

An infection caused by a proliferation of saprophytic bacteria in the lacunæ of the tonsils.

28. *Stomatomycosis,*

caused by the colonization of sarcina on the mucous membrane of the cheeks, and

29. *Thrush,*

the well-known disease caused by the invasion of a yeast-fungus, *Saccharomyces albicans*. These are all troubles of undoubted parasitic nature, while as to

(30) *Stomacace*, (31) *Aphthæ*, (32) *Herpes Labialis*,

opinions are still divided.

33. *Inflammation and Suppuration*

of the salivary glands, in particular of the *parotitis*, must also be mentioned as troubles which in many cases owe their origin to mouth-bacteria which find their way through the ducts to the body of the gland.

Of diseases of a general nature with a localization in the human mouth, we notice briefly

(34) *Diphtheria,*

which may occur primarily in the mouth chiefly after wounds of the mucous membrane (extractions, etc.), or secondarily, the disease beginning in the throat and spreading into the mouth.

The unanimous results of nearly all investigators of the last two or three years have established the Klebs-Loeffler bacillus almost beyond all doubt as the cause, or one of the chief causes, of diphtheria. It is not at all clear, however, in just what manner the bacillus obtains a footing in the mouth or throat. Whether a chance germ from the air lodging upon the mucous membrane of the throat is sufficient to

* Ibid., 1890, No. 15.

† Ibid.

call forth an attack of diphtheria, or whether such germ only under certain predisposing conditions is able to proliferate in sufficient numbers to excite the disease, or whether, finally, the human mouth and throat in particular may harbor the diphtheritic bacilli under normal conditions until the proper moment arises for them to assert their specific action, these are questions awaiting solution.

The fact that an attack of diphtheria may be provoked by slight wounds in the mouth, or by the presence of diseased teeth, and the fact that the extirpation of the tonsils has proved to be one of the most successful prophylactic measures against diphtheria, seem to point to the conclusion that the last-mentioned condition is at all events highly probable.

35. *Tuberculosis.*

Many cases are on record in which primary tuberculosis of the mouth has made its first appearance around diseased teeth or roots of teeth, or following extractions and other operations in the mouth.

Whether or not the bacillus of tuberculosis can exist in the mouths of non-tubercular persons for any length of time is again uncertain. Examinations of the normal saliva have given only negative results, but too much importance should not be attached to this fact, since it is sometimes necessary to examine the saliva even of consumptives repeatedly before finding tubercle-bacilli. A case has been reported where fifty-nine examinations resulted negatively, while the sixtieth disclosed the long-sought-for bacilli. At all events, there is no danger of erring when we assert that the care of the mouth is to be considered as an important factor in the prophylaxis of tuberculosis also.

36. *Syphilis.*

The question of syphilitic infection through dental operations (extraction, filling), through unclean rubber-dam, instruments, drinking-glasses, through kisses, transplantation of teeth, bites, etc., has been so frequently discussed in dental periodicals, and must be so familiar, that a simple statistical inquiry into the question will suffice to show the importance of exceeding great care on the part of the dentist to prevent transmitting the disease to innocent patients. A few cases are presented in the table, Nos. 121-141. Anyone desirous of accumulating more will have no difficulty in finding them. Cases in which syphilis has been communicated by tooth-wounds, bites, slight wounds with instruments wet with saliva, as well as cases where the operator has been infected by syphilitic patients, must be counted by the hundreds.

37. *Infections following Operations in the Mouth.*

In recent years the demand for the adoption by dental surgeons of the same antiseptic measures observed by the general surgeon has constantly become more and more imperative. Attention has been repeatedly called to the fact that bloody operations in the mouth, such as tooth-extractions, performed, as too many of them are, without the slightest regard to the principle of asepsis, often lead to infections of serious nature, which might have been easily avoided; not only that, but carelessness in regard to cleansing the instruments after every operation frequently results in the communication of disease from one individual to another. The following table (No. 71 *et seq.*) speaks for itself. It is only necessary to remark that the cases here cited form but a small proportion of those which have occurred, as every practitioner under whose hands such an infection results will naturally take all possible measures to prevent its becoming public.

38. *Infections resulting from Wounds with Dental Instruments.*

Numerous cases have recently been brought to light in which slight wounds upon the hand inflicted by instruments used in operations upon the teeth, also scratches of the fingers on sharp roots, have resulted in infections of a most serious nature.

To the same category belong infections received through kisses, blows upon the teeth, bites, etc., of which a few only are given below. (Table, Nos. 143-148.)

Stomatitis Epidemica.

Foot and Mouth Disease in Man.

Cases have been reported from time to time in the medical journals, in which foot and mouth disease has been communicated to man from domestic animals, particularly by contact with cows, through milk, butter, etc.

These cases are of a mild nature, exhibiting themselves chiefly in the form of vesicles on the mucous membrane of the mouth, more or less swelling of the gums, etc., but seldom manifesting severe general symptoms.

Under the above title, however, I wish to refer to an affection of a more serious nature, which, as will be shown, in all probability has the same origin as the foot and mouth disease in cattle, but which, being communicated directly from man to man, becomes more virulent than when communicated from cow to man, the relation presumably being the same as that between variola and varioloid.

The epidemic referred to occurred in one of the suburbs of Berlin, a district having a population of nine thousand persons, of which over six thousand have suffered from the disease in the last eighteen months.

Through the kindness of Dr. Siegel, I have been able to make a few observations on the disease, which he himself will soon describe in full in the *Deutsche Med. Wochenschrift*.

The disease first presents itself in the form of dizziness, faintness, and not unfrequently repeated swoons. The face of the patient presents a serio-comic expression, similar to the risus sardonius of tetanus; skin pale, eyes watering, neck stiff, partial trismus, partial paralysis of the tongue, the patients whom I saw being unable to protrude the tip of the tongue more than one-fourth to one-half inch beyond the teeth. One, two, or three days later vesicles appear on the lips, tongue, and in the nostrils; these break open, giving rise to ulcerating surfaces; their contents are serous or often bloody. The gums swell, and in neglected cases putrefaction sets in, the teeth become loose and fall out, the fetor of the breath is intense.

In severe cases bleeding from the mouth, stomach, intestines, bloody feces, bloody urine, albuminuria, intense swelling of liver, clouding of the lens, and blindness are frequent accompaniments or results of the disease. In some thirty cases the disease ended fatally, and in many more it assumed a chronic form, nearly or completely incapacitating the patients for all kinds of labor.

Dr. Siegel has found in the organs (liver, kidneys, spleen, etc.) of all cases (eight in number) where he made the autopsy a micro-organism which he has succeeded in cultivating, and which, injected subcutaneously, causes in goats, calves, and pigs the symptoms characteristic of foot and mouth disease; sections showing again the same micro-organism as found in the tissues of the human subject.

The disease is supposed to have spread chiefly through the beer saloons, where little attention is paid to cleansing the glasses between drinks. Bad hygienic conditions in most of the houses also favor the spreading of the epidemic.

As clearly indicated, the following table by no means presents a complete list of the cases which have been reported. Only within the last few days a number of new cases have come to my notice. There are many deficiencies in the table which might in part have been eliminated if I could have found the necessary time. The majority of them, however, are due to the meagerness of many of the reports in regard to details in the occupation, previous condition of the patient, the course of the disease, treatment, etc.

A LIST OF CASES

in which severe complications resulted from diseased teeth or from operations in the mouth. Those cases denoted by an * were furnished by Zahnarzt Dellevie, and were all observed in the Allgemeines Krankenhaus, Hamburg.

No.	REPORTER.	PATIENT.	CAUSE.	DIAGNOSIS, COURSE OF DISEASE.	RESULT.	REMARKS.
1 *		Man, age 48, healthy.	Diseased lower incisors.	Abscess, osteomyelitis, necrosis, laryngitis.	Death.	
2 *		Workman's daughter, age 5.	Carious tooth in lower jaw.	Parulis, osteomyelitis mandib., metastatic abscesses in lungs, etc.	Death after 4 days.	Treatment: incisions and drainage.
3 *		Workman, age 22.	"	Osteomyelitis mandib., angina Ludovici, glottis oedema.	Death after 1 day.	Treatment: incisions, tracheotomy.
4 *		Boy, age 5.	"	Osteomyelitis of left lower jaw, gangrene of lungs.	Death after 16 days.	Treatment: incisions and tonics.
5 *		Boy, age 4.	Carious teeth in lower jaw.	Diphtheria, catarrh, and later gangrene of lungs, osteomyelitis.	Death.	Treatment: tracheotomy, incisions of alveolar abscesses, tonics.
6	FRAENKEL. Deutsche medicinische Wochenschrift, 1888, S. 931.	Workman, age 30.	"	Osteomyelitis, phlegmon, periostitis purulenta, mediastinitis suppurativa, cedema mediastinalis, pleuritis, pericarditis.	Death 24 hrs. after appearance of phlegmon.	
7-14	SCHUDE. Ibid., S. 949.					Schede saw 8 cases of this nature: he considers them all as hopeless, "the patients die of acute or more chronic sepsis."
15	Private communication.		Caries of lower 3d molar.	Osteomyelitis, phlegmon, cedema of aryteno-epiglottic ligaments.		Result not ascertained.
16	PIETRZUKOWSKI. Oesterr. u. ung. Vierteljahrsschrift für Zahnheilkunde, 1886, S. 363.	Shoenaker's wife, age 26.	Alveolar abscess, i. i. m.	Osteomyelitis, necrosis of articular process of right lower jaw.		Treatment: sequestrotomy, incisions, sublimite irrigation.
17	PEL. Nederl. Weekbl., No. 12, 1882.		Caries of lower molar.	Suppurative periostitis, fever, chills, metastatic abscesses, pyæmia.	Death.	
18	Private communication.	Young workman.	Alveolar abscess.	Ostitis, periostitis, extensive sloughing, acute gangrene, general septic infection.	"	
19	Howse. Med. Times and Gazette, 1876.	Child, age 4½.	Carious teeth in inf. dent.	Suppuration in inf. dent. canal, periostitis, ostitis of vault of skull, general pyæmia.	Death after 9 days.	The teeth and mouth were at the beginning in an exceedingly neglected condition.
20	COOMAN. Corresp.-Bl. f. Zahnärzte, Jan., 1889, S. 56.	Boy, age 8.	Abssc., i. i. m.	Periostitis, septicæmia, metastatic abscesses.	Death after 5 days.	Extr. of tooth failed to arrest the disease.
21	MARSHALL. Dental Cosmos, Dec., 1888, p. 891.		Abssc. of lower wisdom-tooth.	Suppuration, swelling, necrosis, gangrene, sepsis.	Death after 12 days.	

22	*		Driver.	Carious tooth.	Phlegmonous swelling of region of left lower jaw, periostitis mandib. sin.	
23	*		Girl, age 15.	Absc'd tooth, rt. inferior.	Ostitis and periostitis mandib, dext., endocarditis, pleuritis, nephritis, bronchopneumonia.	Death after 4½ months. Treatment: incisions, digitalis, antipyrin.
24	*		Mason, age 6½.	Diseased tooth in rt. inf. max.	Stomatitis gangrenosa, necrosis mandib., pneumonia.	Death after 4 days.
25	GOODHEART.	Med. Times and Gazette, 15 July, 1876.	Boy, age 4½.	Caries of tooth, inf. max.	Abscess, formation of pus in inframaxillary canal, periostitis of lower jaw, spreading of inflam. through fossa pterygo-max. to orbit, suppuration of both orbits, ostitis of the vertex of skull, pyæmia.	Death after 14 days.
26	H. ALLEN.	Dental Cosmos, 1874, p. 569.	Young man.	Diseased wisdom-tooth.	Ostitis, periostitis, abscess, collection of pus about hyoid bone, glossitis.	Loss of ½ of ramus of left side. Death.
27	WHITE.	Ibid., V. XVI, p. 641.	Boy, age 7.	Alveolar abscess.	Necrosis.	
28	MARVIN.	Ibid., 1886, p. 27.	Gentleman.	Abscess of rt. I. after filling.	Extensive sloughing, septicæmia.	
29	*			Abscess.	Septicæmia.	Death in 48 hrs.
30	PONCET.	Gaz. des Hôpît., No. 19.		Carious tooth.	Ostitis, general septic infection.	Death after 48 hours.
31	RITTER.	Deut. Monatsschr. f. Zahnheilk., 1886, No. 8.		Abscessed tooth.	Septicæmia.	
32	MCKELLOPS.	Dental Cosmos, 1890, p. 949.		Accumul. of pus about diseased tooth.	Pyæmia (mistaken for malaria).	Recovery.
33	BEACH.	Dental Advertiser, October, 1890.	Healthy man.	Absc'd tooth.	Metastatic abscesses on pinna, in temporal region, on fingers, etc. with general symptoms. Chronic pyæmia.	Speedy recovery.
34-44	FORRE.	Dental Record, October, 1887.	Young man.	Diseased wisdom-tooth.	Pyæmia.	Recovery after extraction.
45	BAKER.	Ibid., July, 1888.		Abscess of 2d molar.		"
46	BAKER.	Ibid.	Widow in excellent health.	Abscess I. S. 1 m.	Pyæmia, abscess on fourth toe of right side, right ear, forearm, etc.	Forre observed 10 more, similar cases.
47	*		Boy, age 7.	Caries of lower molars	Abscess, inflam. extending along n. inf. max. through orbit into brain cavity, abscess of brain, necrosis.	The pyæmic symptoms appeared after the patient had caught cold in the tooth, and resulted fatally in three weeks.
48	RIEPP.	Dental Record, August, 1887.		Abscess.	Meningitis.	Healed by treating and filling root-canals.
49	MAIR.	Edinb. Med. Journ., May, 1866.		Pericementitis in upper jaw.	Inflam. of Highmore's antrum, caries of the ethmoid, abscess of orbit, arachnitis, encephalitis.	
50	ZWICKE.	Charité Annal., Jahrg. 10, S. 393.	Locksmith, age 23.	Carious teeth in max. inf.	Gangrenous phlegmon, perforation of pus through floor of mouth, emphysema, stinking bloody pus, high fever, dyspnœa.	Treatment: deep incisions, sublimate, etc.

A LIST OF CASES (Continued).

No.	REPORTER.	PATIENT.	CAUSE.	DIAGNOSIS, COURSE OF DISEASE.	RESULT.	REMARKS.
51	SCHWARTZ. Journ. des con. med., 1889, Steward, age 23. No. 17.	Steward, age 23.	Carious tooth r. i. 2 bc.	Angina Ludovici.	Recovery after 3 weeks.	Schwartz is of the opinion that in nearly all cases of this nature the en- trance of the infection takes place through pharynx, tonsils, teeth, or duct of Wharton.
52	WILSON. Dental Review, No. 8, 1890.	Various cases.	Diseased teeth in upper jaw.	Pathological condition of cribriform plate, of ethmoid bone and frontal sinuses.		Wilson observed a num- ber of cases of this kind, in which foul breath, constant discharge from nose, and failing health resulted.
53	A. J. N. Dental Cosmos, 1875, p. 167.		Abscess after filling.	Tetanus.	Death.	
54	COLOMBE.		Diseased teeth.	Phlebitis of the sinuses of the dura mater.		
55	ROCKEV. Private communication.	Woman, age 45.	Dental abscess.	Phlegmon, abscess of orbit and brain.		
56	NICOLAI. Deutsche Monatsschrift für Zahnheilkunde, VI Jahrg., 1888, S. 469.	Lady, age 33.	Carious tooth in inf. max.	Fistula of breast.	Recovery.	
57	V. CARABELLI.		Fistula of armpit.			
58	CANTON. Dental Cosmos, Vol. XXII, p. 672.	Gentleman.	Diseased teeth.	General ill health, diagnosed as carcinoma of rectum.		The infection reached the brain by way of the sphenoid-max. fossa, inf. sphenoidal fissure, or- bit, sup. sphen. fiss. Treatment: extraction.
59	CANTON.	Young wife.	"	Indigestion, sterility.		
60	CANTON.	Gentleman.	"	Cramps of thigh, diagnosis: disease of spinal cord.		
61	* DETZNER. Deut. Vierteljahrsschr. f. Zahn- heilk., 1877, S. 33.	Boy, age 14.	Carious tooth. Parulis.	Tetanus.	Death.	
62	FFENBERGER. Deutsche Med. Wochen- schrift, 1887, S. 553, No. 25.	2 carious teeth in lower jaw.		Inflam. of subcutaneous tissue, perioritis, phlegmon.	?	
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64	PIERCE GOULD. Journ. of Brit. Dent. Ass., April, 1886.	? age 57.	Alveolar abscess, sup. max.	Sloughing, trismus, œdema, thrombosis of cavernous sinus, metastatic abscesses, pyæmia.	Death.	Incision and extr. of 6 molar teeth failed to arrest the disease.
65	SEYDEL. Münchener Med. Wochenschrift, 1889, S. 423.	Boy.	Carious tooth.	Empyema of Highmore's antrum, abscesses on various parts of body.	Recovery.	Treatment: extraction.
66	SEYDEL. Ibid.	Soldier.	?	Abscess of the hip, metastatic abscesses in different parts of the body, pain in process mastoideus.	"	Treatment: trepanation.
67	ROBERT. Conférences de clin. chirurg., Paris, 1886.		Abscess of lower wisdom-tooth.	Purulent infiltration of side of neck, necrosis.	Rapid death.	
68	SCHMID. Oesterr.-Ungar. Vierteljahrs-schrift für Zahnärzte, 1881, Heft 1.		Septic pulpitis of I. i. m.	Intense swelling, abscesses, necrosis, high fever, insomnia.	Recovery.	Not less than 70 pieces were thrown off.
69	R. PARK. Med. News, Oct. 6, 1888.	Young woman.	Diseased lower wisdom-tooth.	Phlegmon, extending from ear to chin, trismus.	Recovery after 2 months.	The mouth was opened by force, tooth extracted, and several incisions made. Completely cured in 11 days by extraction of the teeth.
70	SKOBSBERG. Deutsche Monatsschr. f. Zahnheilk., 1886, S. 13.		Diseased teeth in left upper maxilla.	Total blindness of left eye.	Death after 6 days.	
71	ZAKHAREVITSCH. Vrach No. 34, S. 523.	Physician.	Extr. of I. i. 2 m.	Osteomyelitis.	Death in 10 days.	
72	ZAKHAREVITSCH. Ibid.	"	"	Ostitis, periostitis, general sepsis.	Recovery.	
73	V. MOSKETIG-MOORHOF. Oesterr.-Ungar. Vierteljahrschr. f. Zahnheilk., 1885, Heft 2.	Woman in 7th month of pregnancy.	Attempted extr. of r. i. 2 m.	Angina Ludovici septicæ.		The ang. Lud. was very malignant, for many days little hope of recovery. Treatment: deep incisions, antiseptic dressings, etc.
74	V. MOSKETIG-MOORHOF. Ibid.	Servant girl, age 44.	Attempted extr. of I. i. 2 m.	Intense swelling, gangrene of gums, suppuration, gangrenous phlebitis, myelitis, high fever, œdema of lungs.	Death.	Incision of gums, extr. of roots, antisept. mouth-washes, etc., of no avail.
75	V. MOSKETIG-MOORHOF. Ibid.	Workman, age 39.	Attempted extr. of r. i. 2 m.	Ostitis, phlebitis suppurativa, pyæmia.	"	
76	*	Butcher, age 25.	Extraction of r. i. 2 m.	Phlegmon of neck and face, osteomyelitis, necrotica mandib. dext.	Discharged after 10 weeks.	Treatment: sequestrotomy.
77	*		Extraction of a r. s. m.	Periostitis max. sup. and inf. dext., phlegmon capitis, osteomyelitis, pyæmia, endophthalmitis, abscess in lungs, etc.	Death after 8 days.	Treatment: incisions and drainage.
78	BAUME. Lehrbuch d. Zahnheilk., S. 644.	Student.	Attempted extr. of I. s. 1 m.	Periostitis, necrosis, after 2 weeks pyæmia, bitisophthalmitis.	Death after 14 days.	
79	BAUME.	Young man.	Extr. of a tooth with chronic parulis.	pleuro-pneumonia.	Death after 1 day.	This case should have been classed as septiciæmia.
80	BITTER. Deutsche Monatsschrift f. Zahnheilk., Dec., 1886.	"	Extr. of I. i. molars.	Suppurative periostitis, pyæmia.	Death after 10 days.	
81	*	Boots, age 28.	Extraction of r. i. 3 m.	Phlegmon of floor of mouth, periostitis max. inf. dext.	Discharged after 7 weeks.	Treatment: incisions and sublimate washes.

A LIST OF CASES (Continued).

No.	REPORTER.	PATIENT.	CAUSE.	DIAGNOSIS, COURSE OF DISEASE.	RESULT.	REMARKS.
82 *		Pastry-cook, age 30.	Extr. (fracture) l. i. m.	Periostitis mandib., abscesses.	Discharged after 9 days.	Treatment: incision and drainage.
83 *		Wife of a machinist, age 28.	Extraction l. i. m.	Periostitis mandib., deep-seated abscess in neck, osteomyelitis cruris.	Discharged after 5½ months.	
84 *		Wife of a copyist.	Extr. of tooth in lower jaw, left side.	Swelling, stomatitis, periostitis, abscess, trismus.	Discharged after 4½ weeks.	Treatment: incision, extr. of 6 carious teeth.
85 *		Boy, age 4.	"	Swelling of right lower jaw, abscess, periostitis.	Discharged after 5½ months.	Treatment: incision.
86 *		Waiter, age 18.	"	Periostitis, abscess of lower jaw.	Discharged after 6 days.	Treatment: incision, iodiform tampon.
87 *		Driver, age 26.	Extr. of roots in inf. max. Extraction.	Abscess of cheek, periostitis, osteomyelitis mandib. teeth of lower jaw.	Discharged after 6 months.	Treatment: incision, sequestromy.
88	Private communication.					
89	KOEHLER. Charité Annal., 13. Jahrg., S. 516.	Blacksmith, age 33.	Extraction in inf. max.	Severe septic phlegmon of neck, ichorous periostitis, laryngitis, pharyngitis, pleuritis, broncho-pneumonia, myocarditis, hepatitis, ordema, hypertemia of the lungs, etc.	Death 7 days after admittance.	Treatment: deep incisions, antiseptic dressings, tracheotomy.
90 *		Workman, age 20.	"	Periostitis, profuse suppuration, pyæmia.	Death.	
91	TULPIUS. v. Carabelli, Handbuch der Zahnheilkunde.	Physician.	Lancing gums.	Septicæmia.	Rapid death.	The inflamed condition of the gums rendered it easy for pathogenic mouth-bacteria to establish themselves in the wound. It is not necessary to assume that the lance carried infectious matter.
92	Anonym. Zahnärztl. Wochenbl., Sept. 8, 1888.	Peasant girl.	Extraction.	Hemorrhage, swelling, sepsis.	Death after 2 days.	The wound was in this case neglected, till the septic process was so far advanced as to render all help of no avail.
93	AKLT. Wiener Med. Wochenschr., 1883. No. 9. S. 241.	Boy, age 11.	"	Choroiditis, pyæmia.	Blindness.	

94	DIMMER. Ibid.	Boy, age 13.	Extr. in lower jaw.	Swelling, pain in throat, chills, choroiditis, protrusion of bulb.	Treatment: enucleation.
95	GOLDZIEHER. Ibid.				G. reports a case similar to 93 and 94.
96	LEYNSELE. Bulletin de la Société de Gand, 1885.		Extr. in inf. max., with fracture at pt. of extr.	Meningo-encephalitis.	Pus ascended inner side of ramus, entered cranial cavity through foramina ovale, spinosum and rotundum. The inflammation reached the brain by way of the orbit.
97	DELESTRE. Des accidents causés par l'extraction des dents, Paris, 1870.	Robust man.	Extr. of l. s. molar.	Inflam. extending to brain, meningitis.	"
98	DELESTRE. Ibid.	Factory girl, age 26.	Extr. of r. i. molar.	Swelling, suppurat., meningitis.	"
99	ZAWADSKI. Gaz. lekarska, 1886, No. 8.	Locksmith, healthy, age 46.	Extr. of l. i. 3 molar.	Painful swelling, chills, sweats, stupor, pachymeningitis.	Death after 14 days.
100	V. METNITZ. Oesterr.-Ung. Vierteljahrs-schrift f. Zahnheilk., 1887, Heft 1.	Woman, age 43.	Extr. several teeth.	After 10 days chills, delirium, intense swelling, lockjaw, meningitis, osteomyelitis, stupor, coma.	Death after 10 days.
101	Private case from clinic of Prof. Köcher in Bern.	Woman, healthy, married.	Extraction in inf. max.	Infection of gums and periosteum, swelling, edema, suppurat., abscess, edema of eyelid, exophthalmus, meningitis.	Death.
102	CONRAD. Archives of Dentistry, Nov., 1886.	Servant girl, good character.	Extr. 2 teeth.	Tetanus.	"
103	DILLIES. Medical and Surgical Reporter, Jan., 1878.		Extraction.	Chance of lips 2 weeks after extraction.	
104	OTIS. Lectures on Syphilis, New York, 1887, p. 102.		Filling.	Chance of lips 3 weeks after operation.	
105	*	Workman, age 45.	Extr. 3 molars, 1 in upper, 2 in lower jaw.	Phlegmon of face.	Discharged after 5 weeks.
106	*	Workman, age 39.	Extr. of roots of 1 and 2 upper mol.	Phlegmonous swelling of whole left side of face, high fever, enormous abscess, etc.	Discharged after 5 weeks.
107	*	Painter, age 43.	Extr. 2 teeth in lower jaw.	Swelling, fistula, ulceration of mucous membrane of cheek, necrosis of lower jaw.	Recovery after 3 weeks.
108	SCHÖDE. Deutsche Med. Wochenschr., 1888, S. 949.	Blacksmith, age 41.	Extraction.	Osteomyelitis.	Treatment: sequestromy.
109	FESSLER. Oesterr.-Ungar. Vierteljahrs-schrift für Zahnärzte, April, 1891.		"	Phlegmon extending to breast.	Treatment: removal of outer lamella (discharge of pus), incisions.
110	LINDEMANN. Münch. Med. Wochenschrift, 1887, No. 25.	Woman, age 66.	Extr. of 5 teeth.	Purulent gastritis from swallowing infectious matter.	Death after some weeks.
111	FESSLER. Oesterr.-Ungar. Vierteljahrs-schrift, April, 1891.	Woman, age 26.	Extr. of roots in narcosis.	After some days slimy, purulent sputum, cough, pain right side of breast, pulse 140-160, stinking sputum, abscess.	Death after 10 days.
112	FESSLER. Ibid.	Girl, age 19.	Extr. several teeth in narcosis.	Pneumonia, purulent pleuritis, empyema.	Recovery after 3 months.
					Treatment: incision and drainage.
					Treatment: empyem. operation.

A LIST OF CASES (Continued).

No.	REPORTER.	PATIENT.	CAUSE.	DIAGNOSIS, COURSE OF DISEASE.	RESULT.	REMARKS.
113	BURDETT. Ohio State Journal of Dental Science, 1886, p. 331.	Workman, age 43.	Attempted extr. Extraction.	Swelling, œdema of face, abscess of orbit.	Blindness.	
114	ZAWENY. Charité Anal., Jahrgang 11, 1884, S. 751.	Healthy carpenter, age 45.	Extr. l. i. 2 m.	Inflammatory swelling of cheek with repeated fistulas, abscess of antrum, partial necrosis of upper jaw.	Recovery.	
115	RITTER. Deutsche Med. Zeitung, No. 46, 1891.	Boy, age 4½.	Extr. r. 1 m.	Swelling of jaw and lymphatic glands, trismus, fever, gangrene, necrosis, septice-mia.	Death after a few days.	
116	MADDELUNG. Private communication.	?	Impeded erup. of 3d molar.	Necrosis of alveolar process.	Recovery after 9 months.	Treatment: repeated surgical operations.
117	GALIPPE. Jour. d. conn. med., 1889, No. 40, p. 314 et No. 41, p. 321.	?	"	Repeated swellings and trismus, fistulæ, myositis, meningitis.	Death.	Treatment: extr., subliminate.
118	GALIPPE. Ibid.	?	"	Osteoperiostitis, abscess in fossa pterygoidea.	"	Pus made its way to sinus of base of brain.
119	TUEFFERT. L'union médicale, Vol. II, 1877, p. 618.	?	"	Perimaxillary abscess, abscess of brain.	"	
120	DESREES. Jour. d. conn. med., 1887, No. 13, p. 103.	?	"	Phlegmon, asphyxia, sepsis.	"	Treatment: tracheotomy.
121	BAXTER. Dental Cosmos, 1879, p. 590.	Child, age 3.	Sucking the father's tooth-brush.		Syphilis.	
122	? Ibid., Vol. X, p. 218.	Young lady, age 19.	Bite of her bridegroom in lip.		"	
123	AMBROSOLI. Ibid., p. 390.		Cigartumps.		"	
124	AMBROSOLI. Ibid.		Kiss.		"	
125	MACRY. Ibid., Vol. XIII, pp. 103 and 330.		"		"	
126	MACRY. Ibid.		"		"	
127	HAYWOOD. Ibid., p. 336.		"		"	
128	NIEMEYER. Ibid., Vol. XII, p. 53.	Family of 10 persons.	Sugar teats.		"	
129	? Ibid., Vol. VII, p. 664.	to workmen.	Kiss.		"	
130	? Ibid.		Use of gas-blower's pipe or tube.		"	
131	DECHAMX. Ibid., Vol. IX, p. 161.	Woman.	Extr. and filling.		"	The tube was passed from one to the other.
132	LANCUREAUX. Proceedings Académie de Med. de Paris (L'union médicale, 1889, p. 655).	?	Dental operations.		Chancere of lower lip.	
133	GIOVANNI. Lo Sperimentale, 1889, p. 262.				Chancere of lip.	

134	ROBICKS. Montreal Medical Journal, 1888, p. 93.	Woman, age 30, perfect health. Extr. with con- siderable lacer- ation.	Extr. with con- Sloughing, induration, swelling of glands, etc.	Syphilis.
135	PARKER. Western Dental Journal, Feb., 1890.	Healthy chil- dren, wife of physician. Young woman.	Extraction.	
136	BULKLEY. Dental Review, 1890, p. 347.	Gentleman of position, age 60.	Various dental operations by quack dentist, with unclean instruments. Cleansing.	Syphilitic infec- tion. The disease was subse- quently communicated by the woman to her husband.
137	LELOIR. Leçons sur la syphilis, 1886, p. 62.	Man.	Cleansing and filling.	Syphilis (chan- cre of tongue). Resulting from a wound on the tongue.
138	LYDSTON. Journal of the Med. Assoc., 1886, p. 954.	Woman.	Extraction.	Chancres of gums.
139	DILLIES. Med. and Surg. Reporter, Jan., 1878.	Servant girl, good character.	Filling.	Chancres of lips 2 weeks after extraction.
140	OTIS. Lectures on Syphilis, New York, 1887, p. 102.	Lady.	Transplanta- tion.	Chancres of lips 3 weeks after extraction.
141	Private communication.		Extr. of r. i. c. i.	The transplanted tooth was taken from the mouth of a street-walker.
142	"	"	Bite in left thumb.	Loss of thumb.
143	ROCKEV.	Bartender.	"	Death.
144	ROCKEV.	Violinist.	Wound in fin- ger with dental instrument.	In the course of 2 years no less than 135 ab- scesses formed.
145	ROCKEV.	Lieutenant.	Wound of fin- ger with clasp of plate.	Pus contained spirilla.
146	Private communication.	Dentist.	Carious milk molar.	
148	VERNEUIL et CLADO. Comptes rendus, 1888, Vol. II.		Pain, swelling, chills, high fever, total necro- sis mandib., metastatic abs., meningitis.	The entire necrotic man- dibula was removed by the fingers in one piece.
149	HORSLEV. Lancet, July 24, 1886.	Boy, age 7.		Exitus letalis.

II. THE PATHOGENIC MOUTH-BACTERIA.

The investigations of different bacteriologists during the last five years have brought to light a great number of pathogenic micro-organisms, some of which occur in the mouth with considerable frequency, others having been met with but a few times.

Of those whose cultivation on artificial media has been accomplished, the following are the most important :

1. *Micrococcus of Sputum septicæmia*, which will be treated of in full below.

2. *Bacillus crassus sputigenus* (Kreibohm), found twice in the saliva, once in scrapings of the tongue. Pathogenic for mice, rabbits, etc.

3. *Micrococcus tetrægenus* ; will be described below.

4. *Bacillus salivarius septicus* occurs, according to Biondi, frequently in the saliva of healthy as well as of sick persons ; highly pathogenic for mice and rabbits ; presents great similarity to the micrococcus of Sputum septicæmia.

5. *Streptococcus septopycemicus*, found by Biondi in normal saliva. Saliva containing this micro-organism is pathogenic for rabbits, guinea-pigs, and mice, in quantities of 0.5 to 1 c.cm.

6. *Micrococcus gingivæ pyogenes* (Miller), found four times in unclean mouths ; possesses pyogenic properties.

7. *Bacterium gingivæ pyogenes* (Miller), found in an unclean mouth and in a suppurating tooth-pulp : possesses pyogenic properties.

8. *Bacillus dentalis viridans* (Miller), found in carious dentine.

9. *Bacillus pulpæ pyogenes* (Miller), found in a gangrenous tooth-pulp.

10. *The pyogenic micrococci*.

11. *Actinomyces* (Ray fungus).

12. *Saccharomyces albicans* (Thrush fungus).

13. *Spirillum sputigenum*, found in the mouths of all human beings. Little is known of its pathogenesis, since no one has succeeded in cultivating it. It appears, however, to possess certain invasive properties, as Verneuil and Clado* found it in an abscess of one of the submaxillary ganglia, as well as in a case of adenitis submaxillaris after tooth-extraction and in an abscess following a wound on the finger by the clasp of a plate.

14. *Pancè's pneumococcus*,† found in saliva of healthy persons as well as in pneumonia. Subcutaneous injections cause inflammation of the lungs in guinea-pigs and rabbits.

15. *Bacillus saprogenes* (Rosenbach), found in the white casts in the recesses of the mucous membrane of the pharyngeal wall.

16. *Streptococcus salivarius pyogenes* (Biondi), found in the abscess

* *Comptes rendus*, 1889, p. 272.

† *Rivista clinica et terapeutica*, Agosto, 1886, p. 393.

of a guinea-pig inoculated with saliva from a case of angina diphtheritica.

17. *Coccus salivarius septicus* (Biondi), found in the saliva of a person suffering from puerperal septicæmia.

18. *Micrococcus Biskra* (Heydenreich), found in saliva of persons suffering from "Pendesch" ulcer.

19. *Bacillus bronchitidis putridæ* (Lumniczer), found in saliva of persons suffering from putrid bronchitis.

20. *Bacillus tussis convulsivæ* (Afanassiew), found in the mucus coughed out during the convulsion.

21. *Bacillus pneumoniæ* (Klein), found in the brown or gray sputum of persons suffering from a disease much akin to croupous pneumonia.

22. *Bacillus pneumo-septicus* (Babes), found in the mucous membrane of the pharynx and larynx of a person dead from septic pneumonia.

23. *Pneumobacillus* (Friedländer).

Besides these, a number of pathogenic bacteria have been met with in the human mouth whose cultivation on artificial media has not succeeded. Finally, various other micro-organisms of great importance as exciters of disease appear to be able to maintain themselves for a considerable length of time in the oral cavity, viz: the micro-organisms of syphilis, tuberculosis, diphtheria, hydrophobia, etc.

For the purpose of determining how often the micrococcus of Sputum septicæmia, now commonly recognized as the cause of croupous pneumonia, occurs in the saliva of persons in good health, I undertook the examination of the saliva of one hundred and eleven such persons (with very few exceptions, students at the Dental Institute of the University of Berlin).

Method of Examining Saliva for Pathogenic Organisms.

On account of the large number of different micro-organisms commonly found in the human mouth, it is with few exceptions absolutely impossible to arrive at any conclusion regarding the presence or absence of any particular kind by a simple microscopic examination. Cultures on agar-agar also often fail of their purpose, since many pathogenic mouth-bacteria do not grow on this culture-medium, or they grow so slowly that they are soon overgrown and hidden by the more proliferous saprophytes of the mouth. Gelatine is still less adapted to the purpose.

We must, consequently, have resource to the animal body for the purpose of isolating such pathogenic micro-organisms as may be present in the saliva at the time of the examination.

The person whose saliva was to be examined was always instructed

to intermix the saliva, by rubbing with the tip of the tongue against the cheeks and gums, with dead epithelium or other films and deposits which are often found clinging to the mucous membrane, and constantly carry enormous numbers of organisms. One to two drops of this saliva were then injected into the abdominal cavity of a white mouse.

Of the one hundred and eleven mice thus operated upon, twenty-seven died within fifteen hours; twenty-two in fifteen to twenty-four hours; eighteen in twenty-four to forty-eight hours; eight in two to four days; nine in four to eight days; thirteen in eight to twenty days; four in twenty to forty days; ten being still healthy after the expiration of thirty days, were put down as having escaped infection.

It is quite possible that one or the other of these ten, if kept longer under observation, would still have succumbed to the effects of the inoculation.

In all cases of the first category, the autopsy showed but slight reaction at the point of injection, a varying quantity of a serous or sero-purulent exudation in the peritoneal cavity, and large masses of bacteria among which certain forms appeared almost constantly (Plate I, Figs. 1 and 2). In nearly all of these cases there were forms which, as far as could be determined by the microscopic examination, might be put down as *micrococci of Sputum septicæmia*. In sixteen cases *Micrococcus tetragenus* was present. In three cases a bacillus which will be described later on as *Bacillus buccalis septicus*.

In twelve cases there were large numbers of cocci, staphylococci, and streptococci, the species of which was not determined, and often also a few bacilli of unknown character.

The blood showed in eighteen cases cocci and diplococci (Plate I, Fig. 3), which possessed the characters commonly attributed to micrococcus of *Sputum septicæmia*; a very minute quantity of the blood sufficed to bring about a fatal septicæmia in mice and rabbits.

In two cases micrococci and diplococci were present, which bore great resemblances to the micrococci of *Sputum septicæmia*, but were not apparently identical with them.

In five cases the blood contained bacilli; in two, *Micrococcus tetragenus*; in one case a large capsule bacillus, to be described later on as *Bacillus buccalis muciferens*.

In five cases the blood showed two different kinds of micro-organisms, and in one case three kinds.

In five cases no bacteria were found in the blood. The death resulted from acute peritonitis, complicated in all cases, except the five just mentioned, with septicæmia.

In those mice which died in fifteen to twenty-four hours, the blood was found to contain micro-organisms with only one exception. The *micrococcus of Sputum septicæmia* was found nineteen times, *Bacillus*

buccalis muciferens twice, streptococci once, *Micrococcus tetragenus* twice.

In three cases the infection was mixed.

The appearances presented by the abdominal cavity were not markedly different from those noted in the first category ; on the whole, however, the peritonitis was less intense and the variety and numbers of bacteria not so great.

Of the eighteen mice of the third group (twenty-four to forty-eight hours), eleven showed the *micrococcus of Sputum septicæmia* in the blood, two showed the *Megacoccus buccalis muciferens*, one of the *Bacillus buccalis septicus*, and two unknown bacilli which I did not succeed in cultivating. Finally, in two cases the blood was free from micro-organisms.

Five of the eight mice of the fourth group (death in two to four days) showed the *micrococcus of Sputum septicæmia* in the blood. One showed a large bacillus, named bacillus of *Sputum septicæmia*, described below ; one an unknown micro-organism, and in one the blood was free from micro-organisms.

In nearly all cases there was more or less purulent exudation in the peritoneal cavity, and in one case total suppuration.

Of the nine mice of the fourth group (death in four to eight days), three contained the *micrococcus of Sputum septicæmia* in the blood, one of them *Micrococcus tetragenus*, and in five the blood was free from micro-organisms. In these five cases death followed from a total purulent inflammation of the peritoneum, the peritoneal cavity being completely filled with pus.

Of the thirteen mice of the sixth group (death in eight to twenty days) only two contained sputum cocci in the blood : one a few cocci of unknown species, and one a few fine bacilli. In the other nine cases no micro-organisms were found in the blood. In all, with two exceptions, large abscesses or general purulent inflammation with extensive adhesions in the peritoneal cavity ; in the pus, masses of cocci and a few bacilli.

The four mice of the seventh group (death in twenty to forty days) all suffered from local suppurative processes ; two died from total purulent peritonitis, all the organs of the abdominal cavity being completely imbedded in thick pus with enormous masses of micrococci.

One developed at the point of injection an abscess as large as the end of the finger, which was evacuated on the twenty-first day, after which the animal speedily recovered. The fourth appeared perfectly well till the thirtieth day, when it began gradually to decline. On the fortieth day, when it could scarcely drag itself about the cage and was suffering from profuse diarrhœa, it was killed to put it out of its misery, and at the point of injection a very large abscess was found which had broken into the abdominal cavity.

It will be seen from the above that we may make two grand subdivisions of the pathogenic mouth-bacteria. The first includes those which produce speedy death through blood-poisoning with comparatively slight local reaction ; the second, those which induce fatal pyogenic processes at the point of injection.

With very few exceptions, injections with the blood or peritoneal exudations of the deceased mice produced the same results as injections with saliva.

As separate points of interest may be mentioned—

1. An injection with the secretion from a wound produced by extraction caused a total purulent peritonitis and death in thirteen days.

2. An injection of a drop of saliva into the abdominal cavity was followed in one case by an extensive œdema of the cheeks, lips, and tongue, so that the mouse presented the appearance of suffering from an alveolar abscess on both sides of the jaw. Sections through the œdematous tissue showed enormous numbers of micrococci in the tongue in particular, accumulated in masses between the bundles of muscular fibers. Plate I, Fig. 4, shows a section of the tongue under low power.

The pyogenic micro-organisms concerned in these infections from the saliva will be made the subject of further study. At present I have given my attention almost solely to the first subdivisions of the pathogenic micro-organisms above referred to, and the results obtained I shall produce in the following pages.

I consequently dismiss the subject of the pyogenic bacteria of the mouth with the remark, that, according to my present impression, many of them *do not* belong to the familiar groups of staphylococci and streptococci, since they do not grow on gelatine at room-temperature.

In the one hundred and eleven examinations above recorded, capsulated cocci or diplococci, which, according to present usage, would be called *micrococci of Sputum septicæmia*, were found in the blood of the mice fifty-eight times, and apart from these cases three times in the peritoneal exudations, *i.e.*, in all sixty-one times.

Micrococcus tetragenus was found in all twenty-six times.

During the earlier experiments my attention was directed solely to the micrococcus of *Sputum septicæmia*, and I may have overlooked other organisms, so that in all probability the other species mentioned in reality occur still oftener than indicated by my figures. Accordingly, micrococcus of *Sputum septicæmia* occurred sixty-one times ; *Micrococcus tetragenus*, twenty-six times ; *Bacillus buccalis muciferens*, four times ; bacillus of *Sputum septicæmia*, three times ; bacillus of *Sputum septicus*, six times ; *Pneumobacillus*, once.

Besides these, various other micro-organisms of pathogenic signifi-

cance were met with (apart from the pyogenic ones), which I was not able to study more closely. Twice *streptococci* were found in the blood.

The Micrococci of Sputum Septicæmia.

From the time that Pasteur discovered a deadly micro-organism of the form of the figure 8 in the human saliva up to the present, developments regarding the nature and significance of this organism have followed each other in rapid succession. Besides Pasteur, Raynaud and Lannelongue, Vulpian, Moriggia and Marchiafava, Boche-fontaine and Arthaud, Sternberg, Claxton, Gaglio and di Mattei, Griffin, Klein, A. Fränkel, myself, and more recently scores of others have furnished contributions to the subject of the toxic properties of the saliva.

A great impulse was given to the study of this subject by the discovery by A. Fränkel that croupous pneumonia is caused by a capsule-bearing micrococcus, identical with or the same as the micro-organism observed by Pasteur and those following him. This observation has been confirmed by Weichselbaum, Foa, Bordoni-Uffreduzzi, Netter, and so many others that at present few doubt the etiological connection of the micrococcus of Sputum septicæmia with croupous pneumonia.

The presence of small cocci or diplococci surrounded by a capsule or halo in microscopic preparations from the sputum is also pretty generally accepted as a means of diagnosing croupous pneumonia in doubtful cases. It is, however, a fact that capsule-cocci have been repeatedly found in connection with a large number of different processes accompanying or independent of pneumonia. Thus almost invariably in the emphysema of pneumonia, in pleuritis, endometritis diphtheritica, peritonitis,* pericarditis, and endocarditis,† in cerebro-spinal meningitis, serositis exudativa,‡ otitis media,§ abscesses of the mastoid process, retropharyngeal abscesses, ozæna, rhinitis, coryza, catarrh.|| Foa and Bordoni-Uffreduzzi even give expression to the possibility that the capsule-coccus may be the cause of the rheumatic diseases.

The coccus has also received various names referring to the connection in which it is found, as *Pneumococcus* (Fränkel), *Ozænacoccus* (Löwenberg), *Meningococcus* (Foa and Bordoni-Uffreduzzi), etc.

* Weichselbaum, *Wiener Klin. Wochenschr.*, 1888, Nos. 28-32.

† Guarnieri.

‡ Foa and Bordoni-Uffreduzzi. *Archivio per le scienze mediche*, Vol. XI, 1887, No. 19, and *La Riforma medica*, 1887, No. 39.

§ Moos, *Deutsche Med. Wochenschr.*, 1888, No. 44, p. 902; also Netter.

|| Thost, *Deutsche Med. Wochenschr.*, 1866, No. 10, and Löwenberg, *ibid.*, p. 446.

In view of these facts, the question has been repeatedly asked, Is it possible for one organism to produce so many and such diversified effects? and the idea suggested that the micrococcus of Sputum septicæmia represents not a single species, but a group of nearly allied species. In such case the lack of harmony found in the descriptions and observations of different authors on the pneumonia coccus would be accounted for also.

In my investigations I have met with four different species of micrococci, all of which answer to the description of the micrococcus of Sputum septicæmia, but show certain differences in form and growth which justify doubts as to their identity.

I call them, for the purpose of description only, micrococcus of Sputum septicæmia I, II, III, and IV.

Micrococcus of Sputum Septicæmia I.

This micro-organism proved to be identical with the Pneumococcus Fränkel, of which Dr. Lehmann, assistant of Professor Fränkel, kindly furnished me a culture from a case of meningitis. Like the other members of this group, it grows best on blood-serum, forming slimy, semi-transparent colonies about the size of the head of a pin, which by transmitted light bear a certain resemblance to minute drops of dew. Where the colonies flow together along the track of the needle, they form a ridge with slightly elevated margins, which attains its maximum growth in one or two days.

On agar-agar it sometimes fails to grow altogether, at others it grows nearly as well as on blood-serum, depending upon some slight difference or other in the constitution or reaction of the medium. It forms on agar in line-cultures very small blue-gray semi-transparent colonies, which, where numerous enough to flow together, form a more grayish opaque growth.

Colonies beneath the surface of the agar-agar are gray-brown to yellow-brown, roundish, oval, or pointed, with irregular margin and thick black outline, which, however, is sometimes wanting.

Under a power of two hundred to two hundred and fifty diameters these colonies appear coarse and granular.

Surface colonies under fifty to seventy-five diameters appear round and thin, slightly yellowish-gray toward the middle, colorless at the margin, which is slightly indented or uneven. The surface of the colony frequently presents numerous roundish vacuoles, better seen with a higher power, which give the colony somewhat the appearance of a tissue. A power of two hundred diameters readily shows diplococci, singly or in twos, at the margin of the colony. No growth occurs on gelatine under ordinary conditions.

In the blood and tissues the diplococci are invariably surrounded

by a halo (Plate II, Fig. 7) ; staining in the ordinary methods for capsules usually reveals a capsule.

The diplococci are distinctly elongated, more or less pointed, and often present the appearance of bacilli. They may vary considerably in size in different tissues and in different cultures (Plate II, Figs. 5, 7, 8). On agar the elongated form of the cells is particularly pronounced (Plate II, Fig. 5). Mice injected in the abdominal cavity with the blood or fresh cultures die in about fifteen hours ; injected subcutaneously, in about twenty-four hours ; vaccinated in a skin pocket at the root of the tail, in thirty-six hours to five days ; occasionally they survive the infection. Rabbits and guinea-pigs are likewise susceptible ; dogs are immune. The symptoms are too well known to require description. The micro-organisms are found in the blood and all the organs. The lungs often present a dark-red appearance in toto or only in circumscribed portions ; at other times they are ash-gray. Occasionally appearances are present indicative of a beginning hepatization, the skin being almost invariably cyanotic.

Micrococcus of Sputum Septicæmia II.

It grows under the same conditions as I, but the growth is usually more extensive. On blood-serum it forms a gray, semi-transparent slimy growth, presenting much more the dew-drop appearance than I. Confluent colonies often form masses $1\frac{1}{2}$ –2 mm. in height.

On agar the colonies are seen (under a power of one hundred to two hundred diameters) to be made up of long threads of cocci and diplococci ; the vacuoles present in I are wanting.

Characteristics of this species are the formation of capsules on artificial media, blood-serum as well as agar, the constant presence of long chains, and the slimy character of the growths on agar, as well as in the peritoneal exudations of animals infected with this organism. (See Plate III, Figs. 11 and 12.)

The cocci and diplococci in the blood, as well as in the cultures, are usually less pointed than in No. 1 ; in fact, they sometimes appear quite round.

The hyperæmia of the lungs and the cyanosis are wanting.

Micrococcus of Sputum Septicæmia III

presents many points of similarity with I, but sufficient difference to entitle it, in my judgment, to be considered as a separate, though nearly allied, species.

On agar its colonies present an entirely different appearance from those of I, the vacuoles are wanting, and the surface appears as if made up of innumerable small hexagons, producing a certain resemblance to pleurosigma.

The cells both in the blood and tissues of animals, as well as on artificial media, are more plump and rounded than those of I (Plate III, Figs. 9 and 10). There are also slight macroscopic differences in the growths of I and II. In other points they do not present differences requiring particular mention.

Micrococcus of Sputum Septicæmia IV.

A photo-micrograph of this species is given on Plate II, Fig. 6. It will be seen that it is long and pointed, but much smaller than I. This difference alone would of course not justify the conclusion that it is not the same as I. My reasons for looking upon this organism as a distinct species are to be found in its action upon mice.

I have met with it but once during my investigations. The mice vaccinated with the saliva containing it died inside of twenty-four hours, likewise mice vaccinated with the blood of these inside of thirty hours. The next generation of mice did not succumb till after five days, then followed nine days, while all subsequent vaccinations turned out negatively. In other words, the virulence of the micro-organism rapidly decreased on passing it through the body of mice. In this respect micrococcus of Sputum septicæmia IV differs so decidedly from the other micro-organisms of the group as to justify making an independent species of it.

I think there is no doubt about I, II, and IV constituting separate species, but as to whether the differences noted between III and I are sufficiently marked and constant to entitle the former to an independent position opinions will probably differ.

The different species above described present so many points of similarity, and withal are so subject to slight variations in form and growth, that the question of differentiating between them becomes exceedingly difficult.

I am unable to say whether the forms II, III, and IV have any connection with croupous pneumonia and its sequels. Banti (*Arch. di anata. norm. e patol.*, 1890, Vol. V. Abstract in *Centralblatt f. klin. med.*, 1891, No. 18) describes four species of nearly allied micrococci, all of which are capable of exciting pneumonia. Banti has named them *Diplococcus pneumonia* I, II, III, IV. Foa (*Deutsche Med. Wochenschrift*, 1889, No. 2) also inclines to the view that there are at least two species of pneumococci.

The Loss of Virulence of the Sputum Cocci.

Most observers agree that the micrococci of Sputum septicæmia speedily lose their virulence when cultivated on artificial media. Ten days, seven days, even five days are named as the maximum time for

which the cocci remain virulent when cultivated on agar-agar, blood-serum, etc.

The results which I have obtained do not quite accord with the above. A culture of the micrococcus of Sputum septicaemia II, from the blood of a mouse, on blood-serum, dated May 6, which was kept for seven days at a temperature of 35°C ., subsequently at room-temperature, was used for inoculating a mouse in the abdominal cavity on the 7th of June. The mouse died inside of twenty hours, showing a pure culture of the cocci in the blood. A culture of micrococcus II, twenty-nine days old, caused death in sixty-five hours; a culture forty days old failed to produce any effect.

The cocci were found exceedingly resistive to the action of low temperatures. A mouse, dead of an infection with micrococcus of Sputum septicaemia II, was hung up outside of the window for twenty-one days between the 22d of December and 13th of January, the temperature ranging during nearly the whole time between 5° and 15°C . below zero. At the end of this time the mouse was thawed out, and an infection made with the blood resulted in the death of the infected animal inside of twenty-four hours.

Experiments relating to the Question of Immunity.

It has been well established that immunity may be conferred upon animals by infecting them with material which has been so far weakened in its virulence that the animal sickens but recovers. A subsequent infection, even with a fully virulent culture, is then harmless.

I have attempted to produce immunity—

1. 0.5 c.cm. of dog-blood direct from the artery was injected into the abdominal cavity of mice. Dogs being immune from sputum septicaemia, it was hoped thereby to confer immunity upon the mice. All experiments with dogs' blood, however, turned out negatively. The blood of a large American rabbit, which had been infected without showing any reaction, conferred a partial immunity upon mice, they dying not until the fifth to seventh day after infection, while the control mice died within twenty-four hours.

2. Mice were fed for several days on large quantities of saccharine, with a view to so saturating them with this material that they would not furnish a suitable culture-medium for the cocci. Results were here also only negative.

3. A large number of antiseptic solutions were made use of, injecting the mice before or after, or both before and after the infection, in the abdominal cavity or subcutaneously, with varying results; sometimes the death of the animal being hastened, sometimes slightly retarded. The only substance with which I obtained positive results was a one per cent. solution of trichloride of iodine. If we inject a

mouse subcutaneously with two drops of the water of condensation from a fresh agar or blood-serum culture, or with a slight quantity of diluted infectious blood, and follow up the injection through the same canule with 0.3 c.cm. of a one per cent. solution of trichloride of iodine, the maximal dose for a full-grown mouse, the animal will in most cases survive the infection, though it will lose a piece of skin as large as a finger-nail.

Micrococcus Tetragenus.

This organism was found twenty-six times in one hundred and eleven cases, referred to above, thus proving to be one of the most common pathogenic micro-organisms of the human mouth. My impression is that it occurs still more frequently than indicated in the above numbers, for I may easily have overlooked it in the first fifty cases, where I was watching for sputum cocci only. In the last seventeen cases I found it seven times. In one case only did the death of the mouse result from infection with the *Micrococcus tetragenus* alone, on the sixth day after the infection. The coccus was found in but limited numbers in the blood. The peritoneal cavity contained a large quantity of a slimy or pasty exudation, with numerous *Micrococcus tetragenus* and pus cells (Plate IV, Fig. 15).

An infection with the saliva of the same person four months later produced identically the same results.

A rabbit infected with 0.5 c.cm. of a pure culture in bouillon died in three days, and showed a most pronounced general infection. The blood contained but a moderate number of organisms, which were also present in all the organs and in the bone-marrow. The peritoneal cavity contained about 20.0 c.cm. of a purulent mucous exudation, while the intestines were glued together in one mass by a dense fibrinous exudation, in some places 2 to 4 mm. thick; also fibrinous deposits in the liver and kidneys, spleen greatly enlarged and soft. Pleuritis with slight serous exudation containing *Micrococcus tetragenus* in the pleural cavity.

Guinea-pigs are likewise susceptible.

The micro-organism grows well on all the common nutritive media, and its characteristics of growth are sufficiently well known to be omitted here.

Micrococcus tetragenus has been found a number of times in suppurative processes resulting from diseased teeth. R. Park* found it along with staphylococci in the pus from the phlegmon of an abscessed tooth, Vangel† in the secretion of a tuberculous ulcer of the nose, Steinhaus‡ in pure culture in an abscess at the angle of the jaw.

* *Medical News*, 1888, October.

† *Pester Med.-Chirurg. Presse*, No. 36, 1888.

‡ *Zeitschr. f. Hygiene*, Bd. V, 1889, p. 518.

Bacillus Buccalis Muciferens.

I have given this name to a micro-organism which I found four times in the blood in form of thick, short rods, surrounded by a capsule or halo, while on artificial media the predominating form is the coccus (Plate IV, Fig. 14). It grows well on the ordinary nutritive media, on agar-agar exceedingly rapidly, forming a semi-transparent, slimy paste very much like starch. Ridges 6-8 mm. wide and 1-2 mm. high may be formed in twenty-four hours.

In dilution-cultures in gelatine it appears in forty hours as dark-gray colonies, almost or quite round, distinctly granular, as if made up of an infinite number of little spheres or mosaics. Each colony also shows a number of bright shining spots on the surface. On potato it appears in twenty-four hours as a grayish-white, moist growth, with indented border. In three to four days the growth takes on a yellowish color, appears semi-transparent, while retaining its moist surface. In cultures on agar-agar in particular, the separate cells are surrounded by thick capsules or sheaths, which give to the cultures their slimy nature. The slime dissolves very slowly in most of the ordinary solvents. Weak solutions of alkalies and acids, also solutions of peroxide of hydrogen, slowly disintegrate the mass without apparently dissolving it. Glycerin in one case cleared it up, in another case not (the culture in the former case was twenty-four hours old; in the latter, four days). It is precipitated or coagulated by alcohol and five per cent. solutions of bichloride of mercury, slowly dissolved by one per cent. solution of caustic potash; two per cent. leaves a flaky precipitate. The insolubility of the sheaths renders the devitalization of the cocci by ordinary means very difficult.

Mice infected with the organisms in the abdominal cavity die in fifteen to thirty hours, with varying numbers of bacilli or cocci in the blood and all the organs. In the peritoneal cavity slimy exudations mixed with pus-corpuscles and vast numbers of bacilli, spleen much enlarged, jelly-like exudation as large as a quarter of a dollar at the point of injection. Subcutaneous injections cause death in one to three days.

Guinea-pigs are likewise susceptible; rabbits not sufficiently tested.

Bacillus of Sputum Septicæmia

was found in the blood three times. It bears a close resemblance to the foregoing species, though it is undoubtedly distinct. In the blood, as well as in cultures on artificial media, it occurs in form of thick bacilli, occasionally growing out into threads (Plate IV, Fig. 13). In the former situation, as well as on agar-agar or blood-serum, it is provided with a sheath which readily takes on staining matters.

It grows exceedingly well on the ordinary media. On agar-agar it forms a paste similar to *Bacillus buccalis muciferens*, which is, however, distinctly less viscid; it grows also somewhat more rapidly, and has a milkish gray-white color by transmitted light, in contradistinction to the bluish color of *Bacillus buccalis muciferens*.

Cultures in bouillon develop rapidly, and on shaking send up a shower of minute bubbles, which continue to ascend for one-half to one minute and form a foam on the surface. In this respect it again differs from the foregoing species.

On gelatine the colonies appear in forty hours as very dark, perfectly round, dense, granular bodies with sharp outline, under high power appearing like mosaic-work. Surface colonies form irregular, semi-transparent drops of the consistence of paste (Plate V, Fig. 20). On potato in twenty-four hours extensive growth, cream-colored and moist in the middle, drier and strongly indented toward the border, and in color scarcely to be distinguished from the potato. In forty-eight hours beautiful growth, margins indented and raised; after three to four days, opaque, shining, dirty growth. The paste formed by growths on agar-agar dissolves slowly on three per cent. peroxide of hydrogen, less slowly in weak alkalies. The cells possess no motion. Spores not observed; multiplication only by fission. Stain readily, but lose color after treatment by Gram's method.

The bacillus of *Sputum septicæmia* is pathogenic for mice, guinea-pigs, and rabbits (other animals not tested); symptoms similar to those produced by *Megacoccus buccalis muciferens*. The micro-organisms are found in large numbers in the blood and organs, extensive fibrous exudations and œdema at point of injection, tumor of spleen, etc. This organism apparently possesses many points of similarity with *Bacillus crassus sputigenus*. I was not able, however, to obtain a culture of the latter, and consequently could not determine the relationship of the two.

Pneumobacillus,

more commonly known as *Micrococcus pneumoniae* (Friedländer), need not be described at length, since it may be found in different works on bacteriology, which must be in the hands of most dentists and physicians. It is intensely pathogenic for mice; rabbits are immune.

It will be seen by comparing Fig. 16, Plate IV, with Figs. 5 and 7, Plate II, that there is a certain resemblance in shape between the cells of the pneumobacillus and the pneumococcus; it is to me, however, inexplicable how anyone could for that reason pronounce the two species identical, while the one (pneumobacillus) grows so readily on gelatine, the other not at all.

Bacillus Buccalis Septicus.

In six cases out of the one hundred and eleven the presence of this micro-organism was established by inoculation as well as by pure culture. In other cases a bacillus was found which in shape and color reaction appeared identical with *Bacillus buccalis septicus*, though its identity was not really established by the appropriate tests.

Besides this, the organism in question was found in the pus of an abscess resulting from a wound by a dental instrument. This case, which may be designated as

Chronic Pyæmia caused by the Wound of a Dental Instrument,

presents so many points of interest, and in particular carries with it so severe an admonition, that it will be given in detail.

A young dentist, having accomplished his studies in America, had established himself in a German city and was securing an excellent practice. At this time he had the misfortune to wound the ball of his thumb with a bur with which he was boring out the pulp-chamber of a diseased tooth. The wound was followed by local swelling and suppuration, as well as by swelling of the axillary glands. As it refused to heal, an exploration was made two weeks after the accident, revealing the head of the bur, which had been broken off and remained lodged in the wound. The symptoms disappeared for a time, to reappear in about six to eight weeks in form of an abscess of the lungs and purulent pleuritis. Six weeks of rest and Swiss air brought relief for a time only, the disease reappearing after a lapse of two months in the form of an abscess of the calf of the leg. This was followed during the next two years by no less than one hundred and thirty-five abscesses on every part of the body except the face. The great majority of them were deep-seated phlegmons which were opened in chloroform narcosis.

The general health of the patient varied greatly at different times ; sometimes he would feel comparatively well for four or five weeks, at other times he would suffer so severely that his life was repeatedly despaired of. At the time the one hundred and thirty-second abscess had formed, and when all hope had nearly disappeared, it was suggested to try the action of tuberculine (the Koch remedy for consumption). An injection of the ordinary dose was followed by intense reaction, severe headache, high fever, intense nausea, which, as the patient explained, was not confined to the stomach, but seemed to extend over the whole body ; the very flesh seemed to be nauseated. These symptoms gradually disappeared in the course of twenty-four hours, leaving, however, a sore, painful spot on the left arm at which an abscess formed. A second injection was followed by exactly the same reaction a little less intense, and the formation of a second abscess.

This complexity of symptoms repeated itself five times, each time growing gradually weaker, the last abscess also being comparatively trifling. The general health also improved greatly, so that good hopes were entertained of a permanent cure. These hopes were, however, destined to be sadly disappointed. The abscesses returned again with their former intensity, so that often the only longing of the patient is that death may put an end to his tortures.

In the pus from one of the abscesses I found the *Bacillus buccalis* septicus, which I subsequently repeatedly met with, as above stated, in the saliva of healthy persons. The organism occurs in form of rods, often slightly pointed at the extremities, sometimes growing out into long threads (Plate V, Fig. 18). It has no forward or backward motion, but a rotatory movement about an axis vertical to its length. It grows well on ordinary culture-media, even at room-temperature, better still at 30°-37° C.

On gelatine it forms in two days round or nearly round colonies, with not quite sharp margins, homogeneous or very slightly granular, gray or faintly yellowish-gray. Surface colonies are very thin (Plate V, Fig. 19), bluish, traversed by numerous cracks or fissures, margins indented. In line-cultures it grows rapidly, forming beautiful, indented, velvety, grayish-white ridges. On agar-agar the colonies develop rapidly, attaining a diameter of 1-2 mm. in twenty-four hours. On potato, moderate development in twenty-four hours. center moist, gray, border dry, indented, visible only on close observation. In forty-eight hours the growth is distinctly visible, borders raised and clearly defined. In seventy-two hours moist, thick growth, viscid, dirty yellow, with a tinge of pink. On blood-serum it forms ridges 1-1½ mm. wide and ½ mm. high, of slightly yellowish-white color. Young cells stain readily, all old ones with great difficulty. Often certain zones or points of the rods remain unstained, as seen in Fig. 17, Plate V.

Three rabbits were injected with 0.5 c.cm. of a pure culture in bouillon, one in the abdominal cavity, one intravenous, and one subcutaneously. The first was dead in fifteen hours, the second in thirty-five hours, the third in forty-five hours, with symptoms of acute septicæmia; large numbers of bacilli in the blood (see Fig. 17, plate V) and in the organs, spleen tumor, etc.

White mice and guinea-pigs were likewise susceptible. Cultures on artificial media soon lost their virulence.

III. PROPHYLAXIS.

The probability that one or more different species of pathogenic bacteria are constantly present in nearly every human mouth demands the strictest observance of antiseptic precautions in all operations upon the mouth or teeth.

Not only should all instruments, drinking-vessels, towels, napkins, etc., be kept scrupulously free from germs, but as far as possible the field to be operated upon should be freed from infectious material before the operation is begun.

This point I have discussed more at length in an article on the disinfection of dental and surgical instruments in the July number of the *DENTAL COSMOS*.

The question to which I here wish to call particular attention concerns the measures which should be taken to prevent the undue growth of bacteria, pathogenic as well as non-pathogenic, in the mouth, the ultimate object being not alone to limit as far as possible the action of micro-organisms and their products upon the teeth, but to keep within bounds as well the various diseases which we have seen may result from a lack of proper care of the mouth. It is not necessary to call attention to the fact that a great deal may be accomplished toward freeing the mouth of micro-organisms by the proper use of the tooth-brush, toothpick, floss silk, etc. But even a very thorough mechanical cleaning still leaves hordes of bacteria in the mouth. Besides, there are many conditions under which the brush cannot be used, and but a small minority of the human race understand how to use a brush or seem capable of even learning how. Even those who give the most attention to their teeth and brush them regularly once a day, which is considered a great deal, very seldom succeed in bringing the brush into contact with the third or even the second molars. The dentist accordingly should not fail to furnish his patients with the necessary directions as to how to use the brush and other means employed in cleansing the teeth. The task of finding an antiseptic with an agreeable taste and smell which is sufficiently powerful and rapid in its action to devitalize any considerable number of bacteria during the few moments that it may be kept in the mouth, without at the same time exerting any deleterious action upon the mucous membrane of the mouth or upon the teeth or even upon the general health, is one of the most difficult with which we have to deal in the hygiene of the mouth. Not one of the many mouth-washes with which the market is flooded makes even an approach toward accomplishing this end. For the purpose of disinfecting the mouth in cases of acute diseases, stomatitis, diphtheria, gangrene of the mouth, etc., physicians usually have recourse to borax, boracic acid, chlorate of potash, permanganate of potash, lime-water, salicylic acid, etc., which, with the single excep-

tion of salicylic acid, have next to no action whatever upon the bacteria of the mouth, though some of them undoubtedly have an excellent cleansing action upon inflamed or suppurating surfaces by virtue of which their use may be attended with very beneficial results.

Methods of Determining the Action of Antiseptic Solutions in the Mouth.

In order to arrive at results of the greatest practical value, it is necessary to test the action of the solution upon the bacteria in the mouth itself and not upon pure cultures of bacteria in bouillon. The latter method, while it allows us to determine with great precision the comparative action of various antiseptics, gives results which are too favorable to the antiseptic.

I found, for example, that a mixture of sublimate and benzoic acid, which completely sterilized a pure culture of streptococci in one minute, required at least five times as long to sterilize an equal quantity of saliva. In the experiments to be recorded below, I have employed three different methods.

I.

The mouth being rinsed for about ten seconds with the antiseptic in suitable strength, the latter is evacuated into a sterilized glass vessel, and at definite intervals drops are conveyed on a sterilized platinum needle to tubes of bouillon which are labeled and put into the incubator.

If the tubes, or some of them, become cloudy in twenty-four to sixty hours, we have evidence that the sterilization of the mouth-washings had not been accomplished in the time indicated by the labels on the respective tubes.

The strength in which antiseptics may be used in the mouth was found to be as follows for the substances experimented with :

- | | |
|--------------------------------------------------|---------------------------------------|
| 1. Sublimate, 1 : 2000. | 14. Peroxide of hydrogen, 2-4 : 100. |
| 2. Trichloride of iodine, 1 : 2000—
1 : 1500. | 15. Thallium sulphur., 1 : 1000. |
| 3. Benzoic acid, 1 : 300—1 : 200. | 16. Saccharine, 1 : 400. |
| 4. Salicylic acid, 1 : 300—1 : 250. | 17. Soluble saccharine, 1 : 120. |
| 5. Hydronaphthol, 1 : 1500. | 18. Oil of eucalyptus, 1 : 625. |
| 6. β naphthol, 1 : 1500. | 19. Eugenol, 1 : 750. |
| 7. Lysol, 1 : 200. | 20. Oil of cinnamon, 1 : 400. |
| 8. Carbolic acid, 1 : 100. | 21. Oil of cloves, 1 : 550. |
| 9. Boric acid, 1 : 50. | 22. Oil of latch, 1 : 360. |
| 10. Zinc sulphocarbolate, 1 : 250. | 23. Oil of wintergreen, 1 : 350. |
| 11. Liq. alumin. acet., 1 : 20. | 24. Oil of peppermint, 1 : 600. |
| 12. Thymol, 1 : 2000. | 25. Chlorate of potash, 1 : 40. |
| 13. Alum. acet. tartar., 1 : 60. | 26. Permanganate of potash, 1 : 2500. |

Bichloride of mercury (eight tests) effected a marked diminution in the number of germs in one minute : the complete sterilization, how-

ever, required, on an average, over five minutes. The efficacy of the sublimate was increased to a surprising degree by the addition of benzoic acid.

Trichloride of iodine (seven tests) required an average time of about one and a quarter minutes, proving to be decidedly superior to the bichloride; it is furthermore far less disagreeable than the latter, in fact not at all disagreeable; it has, however, most unfortunately, an acid reaction, and is therefore not suited for daily use as a mouth-wash. In the strength of 1 to 1500 (one test) the sterilization was accomplished in forty seconds.

Benzoic acid (four tests) required 2 to 2½ minutes' time.

Salicylic acid (two tests) required ¾ to 1 minutes' time.

Hydronaphthol (two tests) required over* 15 minutes' time.

β naphthol (one test) required over 10 minutes' time.

Lysol (four tests) required over 5 minutes' time.

Carbolic acid (one test) required over 5 minutes' time.

Boric acid (one test) required over 11 minutes' time.

Zinc sulphocarbolate (one test) required over 7½ minutes' time.

Liq. alum. acet. (one test) required over 5 minutes' time.

Alum. acet. tartar (one test) required over 5 minutes' time.

Thymol (one test) required over 5½ minutes' time.

Peroxide of hydrogen (three tests) required over 6 minutes' time.

Thallinum sulphur. required over 6½ minutes' time.

Saccharine (1 part sat. alcoholic solution to 10 water) required ¾ to 1 minute's time.

Saccharine, sat. aqu. sol., required over 10 minutes' time.

Soluble saccharine required over 5 minutes' time.

The slight action of the aqueous solution of saccharine compared with that of the alcoholic solution is accounted for by the slight solubility of saccharine in water.

Oil of eucalyptus (one test) required over 8 minutes' time.

Eugenol (two tests) required over 10 minutes' time.

Oil of cinnamon (two tests) required over 8 minutes' time.

Oil of cloves (two tests) required over 11 minutes' time.

Oil of latch (two tests) required over 19 minutes' time.

Oil of wintergreen (two tests) required over 12 minutes' time.

Oil of peppermint (two tests) required over 11 minutes' time.

Oil of cassia (two tests) required over 30 minutes' time.

Eau de Bôtot (four tests) required over 15 minutes' time.

* By over fifteen minutes, over five minutes, etc., I do not mean *just* over, but *something* over; thus, over five minutes may be six and it may be sixty minutes. Over five therefore means that the antiseptic was kept under the test for five minutes, and found at the end of this time not to have effected the sterilization.

Eau de Pierre (three tests) required over 11½ minutes' time.

An examination of the above results will soon convince us that there are very few substances at present in the dental materia medica which are available for disinfecting the human mouth.

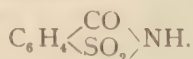
The bichloride of mercury is much restricted in general use by its exceedingly disagreeable taste and by the possibility of a deleterious action upon the health when used daily for a length of time. The trichloride of iodine is hampered by its acid reaction, which restricts its use to acute infectious diseases of the mouth or throat. Salicylic acid labors under a similar ban.

We have accordingly only saccharine and benzoic acid left from which to construct antiseptic mouth-washes *for daily use*, since a substance which requires over five minutes to devitalize bacteria cannot be expected to accomplish much in the short time during which a mouth-wash is kept in the mouth. We may make an exception, however, in favor of the peroxide of hydrogen, which on account of its non-poisonous and non-irritant character may be used more frequently and kept longer in the mouth than the great majority of other antiseptic liquids.

A mouth-wash which I recommended years ago, and which is decidedly superior to the best of the many so-called antiseptic mouth-washes on the market, has the following construction :

R—Acid. benzoic., 3.0 ;
Tinct. eucalypti, 15.0 ;
Alcohol, 100.0 ;
Ol. menth. pip., 0.75.

For the last year I have been making experiments with saccharine, which manifests a very considerable action upon the bacteria of the mouth. It appears also to be one of the least poisonous of the substances recommended for the treatment of the oral cavity, and has no deleterious action upon the teeth. Its greatest drawback is its intense sweetness, which to some persons renders it very unpleasant. It is not, however, the sweetness of sugar, saccharine not belonging at all to the sugars or even to the carbohydrates, being chemically an anhydride of a sulfobenzoic acid,



I have employed it in the following form :

R—Saccharini, 2.5 ;
Acid. benzoic., 3.0 ;
Tinct. ratantiæ, 15.0 ;
Alcohol. abs., 100.0 ;
Ol. menth. pip., 0.50 ;
Ol. cinnam., 0.50.

Three parts of this to twenty-seven parts of water kept in the mouth a full minute has a very marked effect upon the number of living bacteria in the mouth. If instead of water we use a four per cent. solution of peroxide of hydrogen in connection with the tincture, we obtain a still more striking result, as seen in Nos. 14-17 of the table given below.

II.

In order to determine whether or to what degree an actual reduction of the number of bacteria present in the mouth can be effected by the use of an antiseptic wash independent of its mechanical action, a method of experimentation somewhat different from the one described above had to be devised.

The mouth was carefully rinsed with the solution to be tested, keeping it in the mouth just one minute, the rinsing movements being carried out three times every five seconds. Fifteen minutes later the mouth was again rinsed in exactly the same manner with 30 cc. sterilized water. Of this water, 1 cc. was added to a liter of sterilized water, thoroughly shaken up, and one drop of it brought into a tube of melted agar-agar which was poured on a Petri plate. After two or three days the number of colonies which developed were counted.

On the following day at the same hour the so-called control experiment was made, *i.e.* the same operations were repeated, using pure water in place of the antiseptic for the first rinsing. Any marked or constant difference in the number of colonies which develop is to be attributed to the action of the only factor which is present in the first and not in the second, *i.e.* the antiseptic.

The following results were obtained :

	<i>Antiseptic.</i>	No. of colonies	
		No. of colonies.	in control experiment.
1.	Saccharine, benzoic acid mouth-wash ...	47	198
2.	" " " "	82	170
3.	" " " "	51	277
4.	" " " "	58	270
5.	" " " "	63	197
6.	" " " "	50	150
7.	" " " "	35	175
8.	" " " "	51	825
9.	" " " "	14	720
10.	" " " "	49	750
11.	10% peroxide of hydrogen, followed by mouth-wash	12	525
12.	" " " "	6	82
13.	" " " "	4	not made
14.	Mouth-wash in 5% of H ₂ O ₂	14	not made
15.	" " " "	2	345
16.	" " " "	62	421
16 a	" " " "	31	851
17.	" " " "	5	not made

<i>Antiseptic.</i>	No. of colonies.	No. of colonies in control experiment.
18. Sublimate benzoic acid mouth-wash	12	not made
19. " " "	8	not made
20. " " "	2	179
21. Eau de Botôt.....	120	not made
22. " "	275	not made
23. " "	280	not made

The striking and constant difference in the numbers bears sufficient evidence of the efficiency of the antiseptic. In the first seven experiments 20 cc. were used, in the last three 30 cc., which may account for the fact that the latter turned out more favorably for the antiseptic.

One factor which renders the sterilization of the mouth so difficult, is the constant presence of fat, which prevents the antiseptic from readily penetrating small particles of food, as well as from coming directly into contact with the teeth. In the hope of rendering the bacteria more accessible to the antiseptic, I first rinsed the mouth slightly with a ten per cent. solution of peroxide of hydrogen, following it up with the mouth-wash. In other cases again I used the five per cent. solution of peroxide of hydrogen instead of water in preparing the mouth-wash.

The results given in the table 11-17 seem certainly to indicate that the action of the wash is intensified by the addition of the peroxide.

Experiments with the sublimate benzoic acid mouth-wash (the first formula given above, with addition of 0.75 sublimate) resulted very favorably, as seen in the table (tests 18-20).

The celebrated mouth-wash Eau de Botôt, as expected, gave anything but favorable results (tests 21-23).

III.

The action of antiseptic mouth-washes upon the pathogenic bacteria in the mouth was tested in the following manner: One or two drops of saliva intermixed with mucus and epithelium being secured from the mouth of any person in whom it had been found to be fatal to mice in twelve to twenty-four hours, the person rinses his mouth thoroughly with the mouth-wash, and, after waiting fifteen minutes, again produces a small quantity of saliva as before. One to two drops of each sample, the one taken before, the other after rinsing, are injected into the abdominal cavity of white mice. Any marked action of the antiseptic upon the pathogenic bacteria in the mouth would manifest itself in the later death of the mouse injected with the second sample.

In some fifteen tests made in this manner, with the saccharine mouth-wash either alone or in combination with the peroxide of hydrogen, there was not a single case in which sputum septicæmia occurred, although the control mouse died invariably of this disease

in fifteen to thirty-six hours. From these results we must infer that this mouth-wash furnishes a very valuable means of combating the micrococcus of Sputum septicæmia (or of croupous pneumonia) in the human mouth. The wash failed, however, to produce the desired action upon the pyogenic bacteria of the mouth, as well as upon the bacillus of Sputum septicæmia ; the death of the animal injected with saliva containing these bacteria being retarded but not prevented.

